The Engineer

LONDON, FRIDAY, JULY 10, 1942.

PUBLIC NOTICES

WEST MIDLANDS JOINT ELECTRICITY AUTHORITY

APPOINTMENT OF CHIEF ASSISTANT ENGINEER

The Above-named Authority invite APPLICATIONS for the POSITION CHIEF ASSISTANT ENGINEER.
The appointment will be in accordance with the National Joint Board Conditions of Service, at a salary of £1200 per annum, which is deemed to be based on the total capacity of the Authority's generating stations, including immediately proposed extensions.
The post will be a contributory one under the Local Government Superannuation Act, 1937.
The successful candidate will have to pass a medical examination.
Candidates must be Corporate Members of the Institution of Electrical Engineers or hold qualifications of equal standard. Thorough experience in all matters appertaining to Generation and Distribution is essential, and candidates must have occupied positions of senior responsibility in large undertakings including selected generating stations.
Applications, stating age, education, experience and present occupation, accompanied by copies of three recent testimonials, and endorsed "Chief Assistant Engineer," should reach the undersigned not later than 31st July, 1942.
Canvassing, either directly or indirectly, will disqualify.

H. F. CARPENTER,
Clerk and Manager.

Phoenix Buildings,
Dudley Road,
Wolverhampton,
4th July, 1942. 8595

HERIOT-WATT COLLEGE, EDINBURGH

AFFILIATED WITH THE UNIVERSITY OF EDINBURGH)

Full-Time Three Years' DIPLOMA COURSES in MECHANICAL ENGINEERING and ELECTRICAL ENGINEERING.
Mechanical Engineering: Professor A. R. KANE, O.B.E., B.Sc., M.I. Mech. E., M.I.C.E.
Electrical Engineering: Professor M. G. SAY, D.Sc., M.Sc., A.M.I.E.E.
Entrance Examination for those not otherwise qualified for admission, 22nd and 23rd September. Three Scholarships, value £35 per annum, are offered on the results of this examination.
SESSION BEGINS MONDAY, 5th OCTOBER.
Prospectus sent free on application.

J. CAMERON SMAIL,
Principal.

8590

HERIOT-WATT COLLEGE, EDINBURGH

LECTURER IN MECHANICAL ENGINEERING

The Governors Invite Applications from British Subjects for a LECTURESHIP in MECHANICAL ENGINEERING. Laboratory and Workshop experience are essential. Salary scale £300-£15-£500. Candidates will be placed on scale according to qualifications and experience.
Applications must be made on forms to be obtained with full particulars from the College not later than 27th July.

J. CAMERON SMAIL,
Principal.

8599

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the advertisers. These notices (limited to one line) will be free of charge, and co-operation is invited for.

COMPANY, Engaged in the Design and Construction of Power Stations, REQUIRES an ENGINEER of first-class ability and experience for a Senior Managerial Position. The position would carry a salary of not less than £1000 a year and offers very good future prospects. Applicants must have high technical qualifications, first-class experience in this field and must produce evidence of managerial ability.—Address, stating age, education, experience, and salary required, 8602, The Engineer Office. 8602 A

ACTIVE DIRECTOR REQUIRED in Company placing on market new Precision Tool, most essential in all engineering works, which will command large sales.—Address, 8593, The Engineer Office. 8593 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE
ARRANGED FOR CARD INDEXING
(TABLE OF CONTENTS, PAGE 32)

Railway Signalling for Wartime Traffic: No. II (P. 28)
THE ENGINEER, 10 - 7 - 42

Non-Metallic Chemical Plant—No. II (P. 35)
(A. E. WILLIAMS) THE ENGINEER, 10 - 7 - 42

The Kingsley Dam—No. I (P. 35)
THE ENGINEER, 10 - 7 - 42

Production of Uniform Steel for a Light Castings Foundry (P. 38)
(C. H. KAIN & L. W. SANDERS) THE ENGINEER, 10 - 7 - 42

The Engineering Approach (P. 37)
(LT.-COM. R. E. W. HARRISON) THE ENGINEER, 10 - 7 - 42

Construction at Quonset Naval Air Station (P. 29)
(R. V. MILLER) THE ENGINEER, 10 - 7 - 42

Engineers in the Army (P. 32)
THE ENGINEER, 10 - 7 - 42

BABCOCK VALVE VALUE.

INDEX TO ADVERTISEMENTS, PAGE 57

NOTICE

CORRESPONDENCE *re* Accounts and Remittances should be sent in future to:

28, ESSEX STREET, STRAND, LONDON, W.C.2, and NOT to Bath.

This change has been caused by enemy action, and co-operation is earnestly asked for.

SITUATIONS OPEN

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS
1941 No. 2069
RESTRICTION ON ENGAGEMENT ORDER

ENGINEERING PRODUCTION MANAGER is REQUIRED to Take Full Charge of Plant in regard to production, planning, tool design, manufacturing processes, &c. Applicants must be well educated technically and possess at least 15 years' practical all-round experience obtained with firms using modern manufacturing methods. Complete statement covering all points of interest will be treated strictly confidentially.—Address, P4217, The Engineer Office. P4217 A

SITUATIONS OPEN

CLERK TRAVELLER WANTED by London Firm of Agency Engineers, mainly non-ferrous; applicants exempt or over military age.—Address, stating experience, age and salary required, P4212, The Engineer Office. P4212 A

DRAUGHTSMAN, About 21, for Maintenance, Clinker Processing Plant; £360 p.a. Air Ministry work. Resident now in Metropolis and free from Essential Works Order. Interviews Saturday afternoons.—Write only, HIBBERTS, Ltd., Thames Works, Vicarage Crescent, Battersea, S.W.11. P4219 A

HEAD FOREMAN REQUIRED for Light General Machine Shop, employing 30. Scheduled essential works. Applicant must be able to set, give time of operation, &c., and lay out job. Good prospects. Ealing district.—Address, stating details and experience, 8606, The Engineer Office. 8606 A

SITUATIONS OPEN

CHIEF of RATE FIXING and TIME STUDY SECTION REQUIRED by large Midland Manufacturing Organisation employing 5000 persons, male and female, on war work of high priority. Departments include machine and press shops, sub-assembly and main assembly sections, tool-room, &c. The vacancy calls for a man of good education and thorough technical training, and with some years' executive experience on Rate Fixing and Time Study. Actual experience in rating and build-ups from synthetic data is essential, as well as the ability to co-ordinate and control a large staff. An ample salary is available. Please reply in confidence, stating age, education and full details of experience, together with salary requirements.—Address, 8597, The Engineer Office. 8597 A

MAINTENANCE ENGINEER REQUIRED for the Trinidad Government Railway for three years, with possibility of permanency. Salary $T2880, rising to $T3840 a year ($T4·80 equals £1). Free passages. Candidates must be A.M. Inst. C.E. or hold equivalent qualifications, have been thoroughly trained in theoretical and practical engineering on a British Railway, and be capable of taking charge of permanent way, works and signalling equipment, and the supervision and preparation of plans, estimates, accounts, reports, &c.—Write for application form to the CENTRAL REGISTER, C. 1054, Ministry of Labour and National Service, Kingsway, London, W.C.2. 8594 A

MATERIALS CONTROL MANAGER AND ORGANISER.—A Large MANUFACTURING COMPANY, employing 6000 persons on light engineering products of considerable complexity, DESIRES to CONTACT a MAN capable of ORGANISING and CO-ORDINATING Stock Controls, Stores Controls, Buying Sections and Sub-contracting. The position is of a senior classification reporting direct to the Production Controller, and calls for a well-educated man of mature years and extensive executive experience in an analogous position. Experience in the engineering industry is obviously desirable, but applicants from other industries will receive consideration. Ample remuneration and congenial working conditions are available. Type-written applications only are requested, and these must clearly state age, particulars of general and technical education, full details of business training, giving firms served and positions held in chronological order, and indicate salary requirements. Applications will be regarded as definitely confidential.—Address, 8579, The Engineer Office. 8579 A

NEWTON, CHAMBERS and CO., Limited, wish to APPOINT a GENERAL MANAGER for their Ironworks Branch, which includes structural and general engineering departments, with machine shops, heavy and light castings foundries and blast-furnace, with large administrative and sales departments. Applicants must have had previous experience of large engineering works with full responsibility for technical and business administration, also sales management. Preference will be given to those between the ages of 35 and 50. Applicants will be asked to complete a questionnaire, obtained on application to the Secretary of the Company, Thorncliffe Works, near Sheffield. It is requested that no particulars of experience should be sent before the completion of the questionnaire. 8608 A

TECHNICALLY Qualified ENGINEER, with wide experience of modern Iron and Steel Works Plant, Lay-out, and Designs, REQUIRED for permanent position of CHIEF DESIGNER with combine operating Coke Ovens, Blast-furnaces, Open-hearth Plants, Rolling Mills, &c., in England. Position carries responsibility for supervising detailed development by the Company's drawing-offices of designs for extensive new plant installations. Practical experience of Plant Erection and Operating Maintenance Work an advantage.—Address, 8582, The Engineer Office. 8582 A

For continuation of Small Advertisements see page 2.

SITUATIONS OPEN (continued) Page 2
SITUATIONS WANTED, Page 2
AUCTIONEERS & VALUERS, Page 58
PATENTS, Page 2
FOR SALE, Pages 2 and 58
MACHINERY, &c., WANTED, Page 2
EDUCATIONAL, Page 2
SUB-CONTRACTING, Page 2

For Advertisement Rates see First Column Overleaf

CLASSIFIED ADVERTISEMENTS CLOSE FOR
PRESS-NOON WEDNESDAYS

The Engineer

Annual Subscription Rates

(including postal charges)

BRITISH ISLES	£3 5 0
CANADA	£2 18 6
ABROAD	£3 3 0

(except Canada)

ADVERTISEMENTS

The Charges for Classified Advertisements are 1/6 per line up to one inch—minimum charge, 6/-; those occupying one inch or more at the rate of 18/- per inch. Box numbers, 1/- extra except in the case of advertisements under "Situations Wanted." Orders MUST be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address,
28, Essex Street, Strand, London, W.C.2.

Teleg. Address,
"Engineer Newspaper, Estrand, London."
Tel., Central 6565 (10 lines).

SITUATIONS OPEN

UNDER-MANAGER or HEAD FOREMAN WANTED for Engineering Factory on Government work (mostly Non-ferrous) of high priority. Applicants must be fully experienced, accustomed to control and direction of workpeople, having knowledge of Estimating and Ratefixing, Costing, Planning and Progress, and Modern Production Methods generally. Factory is situated in pleasant surroundings in country town in Gloucestershire. Good salary and exceptional post-war prospects in highly progressive firm. Send particulars of career, positions held, &c., in full, stating age, experience in detail, present position, character of work done, availability for release, and salary expected.—Address, 8581, The Engineer Office. 8581 A

HEAD FOREMAN REQUIRED for Small A.I.D. approved Machine Shop, South London area; must be expert Lathe Turner and Capstan Setter, with proved ability. Excellent prospects; permanent position for suitable applicant.—Address, 8605, The Engineer Office. 8605 A

VACANCIES EXIST in the Ministry of Supply (Mechanisation Inspection Department), Chislehurst, Kent, for TECHNICAL JOURNALISTS with experience in writing technical articles for the motor trade and with a knowledge of half-track and full-track vehicles. Specialists in (A) bodies, (B) transmission, (C) engines, or (D) electrical equipment, are particularly desired. The duties will be connected with the preparation of handbooks relative to armoured fighting vehicles and will include a certain amount of travelling. Salary up to £500 per annum, according to qualifications and experience.—Applications by letter only stating age and full particulars of qualifications and experience, to MINISTRY of LABOUR and NATIONAL SERVICE, Central Register (C. 1047), Sardinia Street, London, W.C.2. 8603 A

SITUATIONS WANTED

ABLE EXECUTIVE ENGINEER, Age 37, specialist marine and mechanical, good knowledge electrical, present works engineer, SEEKS RESPONSIBLE POSITION, where competence and energy appreciated. Commencing salary £600. London district preferred.—Address, P4226, The Engineer Office. P4226 B

CHIEF DRAUGHTSMAN (48), B.Sc. (Eng.), A.M.I.C.E., A.M.I.M.E., experienced in structural, hydraulic and general engineering, design, estimating, purchasing, production, SEEKS RESPONSIBLE POSITION directly connected with war effort. Any district.—Address, P4214, The Engineer Office. P4214 B

CIVIL ENGINEER, Age 28, Qualified and experienced in both design and construction of varied civil engineering works on large contracts, SEEKS CHANGE. Near Birmingham preferred.—Address, P4224, The Engineer Office. P4224 B

CIVIL and MECHANICAL ENGINEER, Experience development and technical problems, heavy industries, age 44, engineering degree, DESIRES RESPONSIBLE POSITION in works, technical control or development.—Address, P4207, The Engineer Office. P4207 B

DEVELOPMENT ENGINEER, Inventor Designer, and investigator of mass production problems, experience in light hydraulics and intricate mechanisms, DESIRES PROGRESSIVE POST; age 38.—Address, P4193, The Engineer Office. P4193 B

ENGINEER, Age 30, Ph.D. (Eng.), A.M.I.E.E., experience in heavy and light electrical and also mechanical engineering, research, design, manufacture, and organisation, DESIRES POSITION where initiative and ability could be utilised towards war effort.—Address, P4200, The Engineer Office. P4200 B

ENGINEER (32), Chemical, Civil, Mechanical; 1st Class Degree, 13 years' design and research experience, trained in works management, SEEKS CHANGE to responsible post in which his abilities will be fully utilised. Salary about £700.—Address, P4222, The Engineer Office. P4222 B

SITUATIONS WANTED

ENGINEERING REPRESENTATIVE (48) DESIRES to REPRESENT High-class FIRM. Sound connection, Birmingham, N. Midlands, Staffs, Cheshire, and N. Wales; 20 years' road experience. Highest references.—Address, P4227, The Engineer Office. P4227 B

ENGINEER (34), University Trained, Exp. mech. steam and elect. eng'g., DESIRES RESPONS. POST. Free now. Active and energetic.—Address, P4210, The Engineer Office. P4210 B

EXPERIENCED DRAUGHTSMAN REQUIRES PART-TIME WORK in Mech. Designing, Calculations, Drawing, Tracing, &c. Terms very moderate.—Address, P4221, The Engineer Office. P4221 B

FOREMAN TURNER and FITTER (50) DESIRES CHANGE, or would TAKE FULL CHARGE. Release obtained. Sound practical experience in medium and large marine and general engineering to fine limits. Good organiser.—Address, P4213, The Engineer Office. P4213 B

GENERAL MANAGER (48), Now Controlling 1200 employees, mainly producing aircraft assemblies, SEEKS CHANGE. Present income £2000 p.a. Sound practical and commercial experience. Pre-war 15 years sales director. Intimate knowledge aircraft and automobile industries.—Address, P4228, The Engineer Office. P4228 B

INDUSTRIAL ENGINEER, B.Sc., with Wide experience, American and European, in factory organisation, planning, processing, production and their co-ordination, will UNDERTAKE to SOLVE these PROBLEMS based on modern methods. All writing and interviews strictly confidential.—Address, P4216, The Engineer Office. P4216 B

MECHANICAL ENGINEER, DRAUGHTSMAN, DESIGNER (33), shop trained, high technical ability and administrative experience, SEEKS EXECUTIVE POSITION. Free August.—Address, P4223, The Engineer Office. P4223 B

PRODUCTION ENGINEER SEEKS CHANGE. Established reputation as authority on efficient production of fine-quality work, including planning, tools, rate fixing, costs, organisation and administration. Age 55. Salary £1300.—Address, P4211, The Engineer Office. P4211 B

REPRESENTATIVE (42), Midlands, Well Connected engineering and building trades, DESIRES FIRST-CLASS AGENCY. Extensive engineering experience, works, D.O., and university training. Outside liaison for supplies considered.—Address, P4225, The Engineer Office. P4225 B

STORES/MATERIAL CONTROL MANAGER (48) DESIRES POSITION; 18 years' first-class experience of modern organisation, English and American; previously D.O., m/c shop and costing experience; A.I.D., W.O., and sub-contracts; London or provincial; inquiries confidential.—"MANAGER," 16, Ivor Road, Birmingham, 11. P4215 B

TRACER, Over 31, with Many Years' Experience, can MAKE GRAPHS from Figures, TRACE from Rough Sketches, and, taking mechanical drawing course, WANTS POSITION in Shrewsbury district. Had to leave last job in South on compassionate grounds. Good refs. and samples of work.—Address, P4220, The Engineer Office. P4220 B

PATENTS

THE PROPRIETORS of PATENT No. 466,764, for "Improvements in Rolling Rods and Tubes," are DESIROUS of ENTERING into ARRANGEMENTS with manufacturers by way of LICENCE or otherwise for the purpose of EXPLOITING this invention and ensuring its full development in this country.—All communications should be addressed to H. N. and W. S. SKERRETT, 24, Temple Row, Birmingham. 8604 H

THE PROPRIETORS of BRITISH PATENTS No. 505,114, relating to "Improvements in Multiplying Machines," and No. 505,265, relating to "Improvements in or relating to Computing Apparatus," are DESIROUS of ENTERING into NEGOTIATIONS with one or more firms in Great Britain for the purpose of EXPLOITING the inventions either by SALE of the PATENT RIGHTS or by the GRANT of LICENCES on reasonable terms.—Interested parties who desire further particulars should apply to ALBERT L. MOND and THIEMANN, of 14 to 18, Holborn, London, E.C.1. 8596 H

MACHINERY, &c., WANTED

WANTED, CORE WIRE STRAIGHTENING MACHINES, complete with MOTOR. Full particulars.—Address, 8607, The Engineer Office. 8607 F

WANTED, TWO HIGH-PRESSURE BOILERS, minimum 160 lb. per square inch, but 200 lb. if possible, 30ft. long by 8ft. 6in. diameter, with all fittings. Send insurance certificate, state best price and where seen.—Address, 8592, The Engineer Office. 8592 F

ALL CLASSES OF MACHINE TOOLS WANTED. Cash paid.—NORMAN POTTS, 105, Alcester Road South, Birmingham, 14. 8586 F

We are licensed by the Machine Tool Control for the purchase of all classes of Machine Tools, and we offer good prices for surplus Machinery in any quantities, large or small.

F. J. EDWARDS, LTD.
359, EUSTON ROAD, LONDON, N.W.1
Telephone No.: EUSton 4681
Telegrams: "Bescotools, Norwest, London."

ALFRED HERBERT, Ltd., Coventry, PAY BEST PRICES for SECOND-HAND MACHINE TOOLS in good condition by first-class makers.

Write, wire, or 'phone and our representative will call.

'Phone: 88781 (12 lines), Coventry; Telegrams: "Lathe, Coventry." 1002 F

SUB-CONTRACTING

WANTED

AN ENGINEERING FIRM, Now Fully occupied, is LOOKING for FUTURE MANUFACTURING OPPORTUNITIES that would provide for the post-war employment of its operatives, approaching 1000 in number. CONTACT is therefore SOUGHT with MANUFACTURERS or MERCHANTS who anticipate that they may later on need quantity supplies, either of parts or finished products to their own specification. (As an example, a manufacturing arrangement has already been made with one section of the motor industry.) To a thoroughly modern outlook and a knack of getting things right in spite of obstacles, advertisers add first-rate facilities for, and experience of, Multiple Production in Steel, Light Alloys, &c., ranging from Simple Machining, Welding, Press Work, &c., to the Complete Manufacture to Specification of large assemblies, hydraulically and electrically operated.—Replies, which will be treated in strict confidence, should be addressed to THE ADVERTISERS, c/o F. G. Allen, Sons and Blake, Solicitors, 15, Landport Terrace, Portsmouth. 8560 MW

LARGE CAPSTAN CAPACITY AVILABLE.—Repetition CHUCKING WORK in Non-ferrous Materials up to 3in. dia. Long run is essential.—Address, 8591, The Engineer Office. 8591 MW

MACHINING WORK REQUIRED, Large or small lots, suitable for Centre Lathes (9in. crs. by 8ft.), Slotters, Drills, Shapers, Planers, &c.—STRINGERS, Ltd., Wincobank, Sheffield. 8084 MW

OFFERED

REQUIRED, ENGINEERING FIRM to Undertake the MANUFACTURE of SMALL MACHINES against samples and drawings; patterns and castings could be supplied. Continuous runs of priority work. Please send details of plant available for this work.—Address, P4209, The Engineer Office. P4209 MO

EDUCATIONAL

AUTHORITATIVE CORRESPONDENCE TRAINING

25 FIRST PLACES

and HUNDREDS OF PASSES in the A.M. Inst. C.E., A.M.I. Mech. E., A.M.I. E.E., A.F.R.Ae.S., A.M.I. Chem. E., C. & G., etc., Examinations have been gained by T.I.G.B. Students.

Especially in view of Air Raid and Working Conditions, study at home with the T.I.G.B. in order to achieve the best progress and results. Write to-day for "The Engineer's Guide to Success"—FREE—containing the world's choice of Engineering Courses—over 200—covering all branches and recognised qualifications. Mention branch, post of qualifications that interests you. The T.I.G.B. guarantees training until successful.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
76, TEMPLE BAR HOUSE, LONDON, E.C.4.

FOR SALE

THOS. W. WARD LT

ASQUITH Pillar Type SIDE MILLING DRILLING HEAD, 2¼in. M.T. bala horizontal spindle, gear-box drive, 1 cross movement, vertical movement of on pillar 7ft. 11in., cross movement vertical column on bed 54in., all motion power, driven by Royce 220 volts, 950 r.p 78 amps. D.C. motor and starting ge ment, direct pinion drive. Overall 17ft. 6ft. 4in. by 16ft. 4in. high; 8 spindle spe 10 to 190 r.p.m.; 16 vertical feeds, 1.5in 20in. per minute; 4 horizontal feeds 1.15in. to 4.1in.

20in. swing Gisholt COMBINATION TUR LATHE; power feed all directions, rapid power traverse to turret; 3¼in. hollow spindle. Hex. tilted turret, across flats with 2¼in. dia. holes; 3 cone drive, back geared; 3-jaw indep. ch

12ft. by 5ft. by 5ft. PLANING MACH (Loudon Bros.), Lancashire type, d Table w.s. 12ft. by 4ft. 5½in., overall by 4ft. 5in.; rack driven; 24 H.P. and M. Motor, 290 v., 460/920 r.p.m., wound, and L.D. and M. Generator, 20 1280 r.p.m., compound wound, interm rated.

3ft. swing, box bed type SENSITIVE RA DRILLING MACHINE (Town), 1 3/16in. spindle, No. 3 M.T., tee-slotted box 25in. by 45in. by 10½in. deep. Arrange belt drive to spindle through 1 H.P., 4 3-ph., 50 cy. Motor, by Wright E.P.S., 860/1440 r.p.m.

Double-ended PUNCHING MACHINE, Bennie, with Angle Cropper in the c capacity 1in. to ¾in. Machine arranged motor drive with crane.

Write for "Albion" Catalogue.

'Grams: Forward, Sheffield." 'Phone: 26311 (15 li

ALBION WORKS, SHEFFIELD.

CAPSTAN LATHES, 2in. Milholland, Foster.

HORIZ. MILLERS, Ward 54in. by 1

Le Blonde 56in. by 12in.

UNIVERSAL, No. 3 Cincinnati 46in. by

VERTICAL MILLERS, No. 6 Becker, M Becker, and No. 3 Becker.

H. W. WARD TURRET LATHE, 3½in. 10in. centre, with equipment.

AUTOMATIC, 4¼in. Cleveland, single spi with equipment.

HORIZ. BORING MACHINE, No. 4 Ke table 36in. square.

PLANO MILLER, by Ingersoll, all-ge table 10ft. by 2ft., with four milling heads.

RICHARDS SIDE PLANING MACHI 21ft. bed, double-headed, two drives, 2ft. reach.

TWO Four-spindle, Heavy-duty, All-ge ARCHDALE DRILLS.

ALSO Lathes, Grinders, Automatics, &c.

NORMAN POTTS, 105, Alcester Road So Birmingham, 14. 8587

For continuation of Small Adverts ments see page 58

Vertical Milling Machin
all geared, hardened and ground throughout, h and roller bearings, swivelling head, 30" x8" Ta
HENRY MILNES LIMITED, Machine Tool W
Ingleby Street, BRADFORD

SCISSORS OF AL DESCRIPTI
for PRIORITY AND WAR WORK O
CHAMPION (SCISSORS) LT
99, Champion Works, SHEFFIELD

BRITISH "REMA"
Manufacturing Co. Ltd., SHEFFIEL
(Proprietors: EDGAR ALLEN & CO., LTD.)
Unit Air Separators.

CASTINGS
in grey iron and alloyed for high test, wear and heat resisting
R. GOODWIN & SONS (ENGINEERS) L
Ivy House Foundry, HANLEY, Stoke-on-Tr
Tel.: 2256 Stoke-on-Trent

LIFTING MAGNETS CHUCKS & CLUTCHE
RAPID MAGNETTING MACHINE COMP. L
MAGNET WORKS, LOMBARD ST., BIRMINGHAM

YOU have been waiting for - - - **THE PERFECT**
DIBYCOIL **RUST-SOLVENT**
REGD. TRADE MARK
Indispensable for Engineers
Full details from
DIBYCO LIMITED
STAR WORKS,
BOSTON ST., SHEFFIELD 2
Scottish Agent and Stockist:—
JAMES CALDWELL,
101, St. Vincent Street, Glasgow, C.2
DIBYCOIL
loosens everything rustbound
prevents friction and helps to lower repair costs, as it saves time, temper and money. It is economical in use and should ALWAYS BE AT HAND WHERE RUST PROBLEMS MAY OCCUR. AGENTS REQUIRED IN ALL DISTRICTS

A Seven-Day Journal

National Institute of Agricultural Engineering

THE nucleus of the new National Institute of Agricultural Engineering, set up at Askham Bryan, near York, by the Agricultural Machinery Development Board, is the Institute of Research in Agricultural Engineering at Oxford, which the University of Oxford has handed over to the Ministry of Agriculture. It is announced that Mr. S. J. Wright, M.A., the Director of the Oxford Institute, has been appointed Director of the new Institute. It will be housed temporarily during the war period in the buildings at Askham Bryan, belonging to the Yorkshire Council for Agricultural Education. The staff of the Institute will be considerably strengthened, and work is now proceeding in the equipping and arranging of the necessary engineering workshops and testing appliances. When, after the war, the Askham Bryan buildings have to revert to their original purpose, it is intended to build a permanent home for the Institute near the temporary accommodation, as it is felt that Askham Bryan is a particularly advantageous site, being almost in the middle of Great Britain and in a part of the country where both agriculture and engineering are industries of outstanding importance. In contrast to the old Institute, which was engaged on research work, the new Institute will deal with the more practical aspects of testing and adaptation. Pure research will be dealt with by the D.S.I.R. and the Agricultural Research Council. The main functions of the new Institute will be to act as a general clearing house for information about agricultural machinery and its use, to carry out tests or demonstrations of new or improved implements, to undertake experimental and demonstration work on the better utilisation of existing equipment, and to fill the gap between inventor and manufacturer by putting new ideas into practical shape and constructing the prototype machine. Inventive farmers have often produced machines that were promising solutions of some problems, but in most cases they have not had the means to carry out the difficult and expensive job of turning an idea into an efficient machine, so designed that it can be produced in quantity at a reasonable price. When the whole system is working properly, there should flow into the Institute ideas from the farmers along with their first crude inventions. There should also flow in new machines and new proposals put forward by manufacturers who wish tests to be applied quickly in order to determine whether the designs are sound. After expert examination and testing by the Institute there will then be available practicable propositions for commercial development by manufacturers.

The German Battle-Cruiser "Gneisenau"

ACCORDING to the Air Ministry News Service, photographs taken recently by R.A.F. reconnaissance aircraft, over the Polish Baltic port of Gdynia, show that the German battle-cruiser "Gneisenau" has received such damage as will likely keep her out of action for a considerable time. This is especially likely, as Gdynia is a port with few facilities of heavy naval repairs. The photographs, which have been subjected to close microscopic examination, show that the three main 11in. gun turrets of the ship are being dismantled. The gun house has been completely removed from the forward turret, while the "B" turret forward and the "Y" turret aft have been partly dismantled and the guns taken away. Some 30ft. of the forward deck of the cruiser has been opened up and camouflaged netting is laid between the ship and the side of the dock at which she is berthed. It will be recalled that the "Gneisenau" was removed to Gdynia about the end of March or the beginning of April, because of the heavy British air attacks on the naval base at Kiel, where the battle-cruiser was docked in order to undergo a more thorough examination and repair than was possible at Brest. During her stay at Kiel she was bombed on more than one occasion, and on the night of February 25th photographs showed a fire on the liner "Monte Olivia," which was lying near the cruiser in the inner construction basin at Kiel, and was acting as her depot ship. The liner was completely burned out and all her superstructure destroyed, and it seems likely that the "Gneisenau," which was lying quite near her, was also hit during the same raid. Although the port of Gdynia is not a generally recognised naval repair depot, the "Gneisenau" may have been docked there as a further measure of safety, always bearing in mind that Gdynia is not far distant from Danzig and Elbing with their famous Schichau shipbuilding yards.

Sir Harold Brown's New Appointment

IT is announced by the Ministry of Supply that the post of Senior Supply Officer in the Executive of the Ministry has been filled by Engineer Vice-Admiral Sir Harold Brown, who, we may recall, has been Controller-General of Munitions Production since the inception of the Ministry of Supply in 1939. Sir Harold has taken a leading part in the rearmament of Britain since 1936, when, on resigning the office of Engineer-in-Chief of the Fleet, he was appointed the first Director-General of Munitions Production. In June, 1939, that post was absorbed in the Ministry of Supply, then newly created, and Sir Harold became at a later date the Controller-General. The vacancy created by Sir Harold's new appointment has been filled by Mr. Graham Cunningham, who has been Director-General of Production Services in the Ministry of Supply since he left the War Damage Commission in August, 1941. Mr. Graham Cunningham now becomes Controller-General of Munitions Production.

A Fen Flood Protection Scheme

AT a meeting which took place in the Engineering Laboratories at Cambridge University on Thursday afternoon, July 2nd, at which over one hundred representatives of the authorities and drainage boards in the area were present, Sir Murdoch MacDonald and Mr. Oscar Proude, the consulting engineers to the Ouse Catchment Board, explained the new £2,000,000 scheme for Fen floods protection. The speakers were welcomed by Alderman W. C. Jackson, the Chairman of the Great Ouse Catchment Board, who presided. It was in 1919 that Sir Murdoch MacDonald and Partners were appointed consulting engineers to the Board, and their report was issued in 1940, giving for the first time complete calculations and concrete figures of the results which were to be obtained. In opening his description, Sir Murdoch MacDonald emphasised that he and his partner were not concerned with drainage in the ordinary sense of the word, but were asked to deal with flood protection, and incidentally with protection against the sea in tidal rivers. The scheme put forward, he said, protected the South Level, but that was not the only area; 20 per cent. of the estimate was for the protection of the uplands and about another 20 per cent. for the areas which lay below the South Level. He then referred to the original £4,000,000 scheme and the modified £2,000,000 scheme and to the partial scheme in existence suggested by Mr. Griffiths, one of the Board's own engineers, which, he said, was very similar to the end part of his and Mr. Proude's own scheme. Mr. Proude dealt with some of the details of the scheme, and stressed the fact that, while the high-level rivers flow through the South Level, with high banks of peat, the Middle Level only has water on its edge. The ideal scheme, Mr. Proude went on to say, was to bring the water through the new cut round the South Level to Denver. He explained the proposal to construct a relief channel from Denver to St. German's, designed to run at a slope of 6in. to the mile, and also the proposal to widen and deepen the Ten-Mile River. When the tidal gates at St. German's were closed there would be, he said, 700 acres of wash land to store water. The Magdalen bend would be straightened and that would give an opportunity to construct a barrage in the dry—a cheap method. In conclusion, Mr. Proude mentioned that the scheme was designed to deal with a flow of water 25 per cent. greater than in the 1937 floods, and thanked the Board's Chief Engineers, Mr. Doran and Mr. Griffiths, for their co-operation.

The Late Commander Sir Walter Windham

COMMANDER SIR WALTER WINDHAM, whose death occurred at "Tyrcelyn," Builth Wells, on Sunday, July 5th, was a pioneer motorist and did much for the development of British aviation. He saw service as a Queen's Messenger and King's Messenger in India and Russia, was mentioned in dispatches for connecting the R.I.M.S. "Warren Hastings" with a rope to the shore and enabling 1200 men to be landed, and voyaged round the world four times in a sailing ship. He served in France during the last war, but he will be most remembered for the part he played in the early days of British motoring and aviation. He took part in the first motor-car drive to Brighton, and was the first to carry foreign dispatches by car. At Doncaster he controlled the first aviation meeting, and at Bournemouth in 1911 he entered a monoplane and a biplane constructed by himself and gained a prize. He it was who, in 1908, offered the gold cup for the first airman to fly the Channel, which in 1909 was won by Blériot. The two airway services he started in 1911 must be regarded as among the earliest of their kind. One was in India, from Allahabad to the other side of the River Ganges, and the other in England, where an air mail service was set up between Hendon and Windsor. In connection with this service special stamps and envelopes were issued, and with the proceeds of the service Sir Walter endowed a special bed for airmen at King Edward's Hospital, Windsor. Although he took such an interest in flying, he did not fly a great deal himself, but on one occasion in 1910 he crashed at Brooklands. He was awarded two medals by the Royal Humane Society, and was twice recommended for the Albert Medal. Sir Walter was knighted in 1923, and in 1933 he was made a Freeman of the City of London.

New Directors for the Coal Industry

THE Minister of Fuel and Power has announced the names of the four new Directors, who, in conjunction with him and Lord Hyndley, the Controller-General, will carry through the Government's plan for the reorganisation of the coal industry. They are as follows:—Production Director, responsible for efficiency and volume of production, Mr. T. E. B. Young, a director and general manager of the Bolsover Colliery Company; Labour Director, responsible for welfare, safety, health and working conditions of the mines and allocation of labour, Mr. J. Armstrong, who was Vice-President of the National Union of Scottish Mineworkers and General Secretary of the West Lothian Mineworkers' Union; Services Director, responsible for distribution and allocation of coal, Mr. J. Innes, who was Deputy Controller-General of the Mines Department and formerly Director of Telecommunications at the General Post Office; Finance Director, responsible for all financial arrangements, including advice on coal prices, Mr. D. W. Coates, Chief Accountant of the Central Electricity Board, and latterly Honorary Financial Adviser to the Petroleum Department. The names of the Regional Controllers and the three assisting Directors, one dealing with engineering matters, the other with the labour services, and the third with the public services, such as gas, electricity, transport and distribution, have still to be announced, along with the National and Regional Coal Boards.

Railway Signalling for Wartime Traffic

No. II

(*Continued from page 4, July 3rd*)

SCHEMES for improvement of freight train operation while traffic is on the move must, to be fully effective, be co-ordinated with the working at reception and distribution centres; and unless the maximum flow is amply provided for the reduction in journey time effected by one or more of the track and signal lay-outs discussed in the first part of this article may merely lead to congestion in marshalling yards, goods stations and in the approaches to vital ports. In the present emergency the density of traffic varies considerably from week to week. As compared with the regular coming and going of merchant ships in peacetime, there are now periods of extreme pressure following the arrival of convoys; then speed is doubly vital, for ensuring the quickest possible turn round of ships, and for ensuring the rapid distribution from a vulnerable area of the cargoes unloaded. Always, the key to efficient operation in such circumstances is to be found in the lay-out of the marshalling yards.

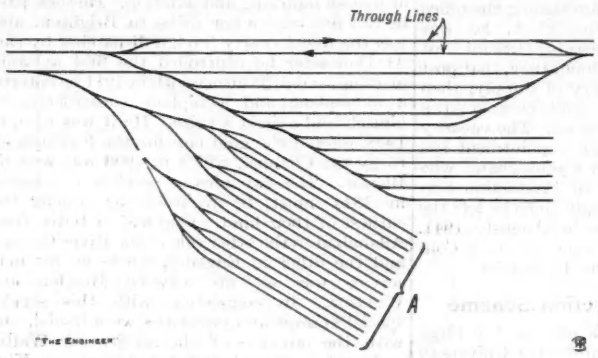


FIG. 11—LAY-OUT OF MARSHALLING YARD

Conditions vary very much between one locality and another, and in an article of this kind it is not possible to do more than indicate the broad general classifications in which such yards may be grouped. In certain places wartime traffic has compelled the laying out of entirely new yards; elsewhere existing arrangements have been improved, while fully mechanised yards, designed for the heaviest peacetime duty, have proved of inestimable value under the exacting demands of war. Generally the purely wartime project forms a necessary adjunct to a broadly conceived strategic plan, and the traffic can be estimated probably with greater accuracy than in the case of a scheme designed to cope with the fluctuations of ordinary commerce. On the other hand, the application of modern signalling principles to increase the capacity of an existing yard is often fraught with some difficulty, owing to the diversity of schemes open for consideration; from among these it is not easy in the investigation stage to pick out the one that would eventually prove most suitable to actual conditions.

Fig. 11 illustrates an extensive lay-out such as is used for the classification of traffic from a port. A comparatively small proportion of the sidings is arranged for through working, and loaded trains arriving from the tracks alongside the steamer berths are remarshalled for their ultimate destinations in the single-ended group of sidings designated A. The yard is laid out on the level, and so anything in the way of continuous shunting is not possible. This, indeed, is an example of classification sidings arranged in the simplest way for rapid construction and for economy in first cost. A yard of this kind has the advantage that it can be built and put into use section by section, to a programme corresponding with the commissioning of new steamer berths at the port. Connections to the main line, at both the entering and leaving ends of the yard, will be controlled by mechanical interlockings, each constituting a block post so far as through traffic is concerned. These interlockings follow established practice and require no further comment.

Within the confines of the sidings there is scope for the saving of man power by the use of centralised control appliances. In such yards it is usual for all the points to be operated by hand throw-over levers, worked by men specially allocated to that duty. From an examination of the lay-out in Fig. 11 it will be readily appreciated that a considerable number of men would need to be so employed if sorting is to be expeditiously carried out. Some saving could be effected by grouping certain points for operation from ground frames with, say, six pairs under the control of one man; although with hand braking care would have to be taken to keep the 6ft. way everywhere as clear as possible of point rodding. With shuttle, as opposed to continuous, shunting it would be quite possible for one man, from an elevated platform, to control point operation over the whole group of sidings, although electric working would then probably be found necessary.

The group of sidings designated A in Fig. 11 is laid out on the balloon principle; this is effective in concentrating the points as close as possible to the shunting neck, but it has the disadvantage, so far as hand operation is concerned, that four pairs of points have to be negotiated to reach any one siding, and that successive shunts may require the throwing of four hand levers. When the matter of expediting yard operation by application of the principle of hump shunting was first taken in hand in this country several important yards were arranged on the "ladder" system. Two variations of this type of lay-out are illustrated in Fig. 12, and in both it will be seen that wagons have to negotiate only one pair of points after the king points K1 and K2 have been cleared. In the lay-out shown in Fig. 12 (*a*) there is a central pathway which the pointsmen have no need to leave; in Fig. 12 (*b*), which shows a pointsman's path at each side, it may be that more operators will be required than with lay-out 12 (*a*), but it has the advantage of giving pointsmen an uninterrupted view of traffic passing over the hump.

Yards of this kind, non-mechanised, with hand braking of the wagons, and hand throwing of the points, have been proved capable of dealing with a steady flow of 100 wagons per hour, week in, week out. But to handle such a traffic a staff of at least seventy men per shift is required, meaning a total of over 200 to operate a twenty-four-hour day. Complete mechanisation would enable the speed of humping to be increased, but analysis of train operation through such yards has shown that the actual process of propelling wagons over the hump occupies only about 30 per cent. of each twenty-four

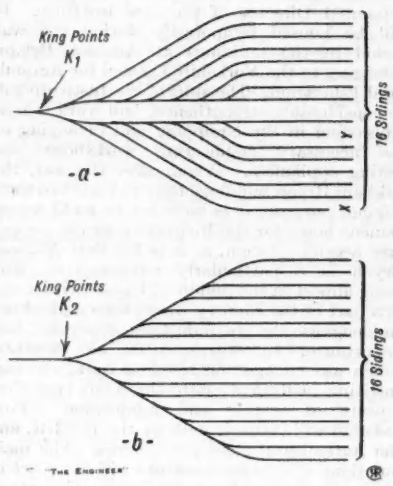


FIG. 12—"LADDER" SYSTEM

hours. A far greater saving through mechanisation is to be realised in labour, thus in the present emergency releasing men for duty elsewhere and reducing operating costs in the yard itself. Complete mechanisation, however, includes the use of power-operated rail brakes, in addition to power working of the points, and unfortunately the ladder type of yard cannot readily be adapted to so complete a change in operating methods. Where rail brakes are employed it is desirable that running conditions should be as nearly equal as possible for every route; the resistance due to curvature of the track has a considerable effect, particularly on empty wagons, and there is, with a yard such as that shown in Fig. 12 (*a*), a considerable disparity between the distance covered in reaching siding X and that in reaching siding Y. Such physical characteristics would call for more expert judgment in controlling the rail brakes than could be reasonably expected and require a finer degree of adjustment in brake power than it is practicable to provide.

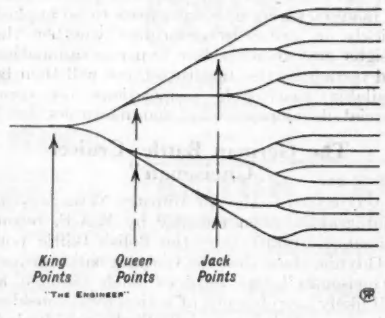


FIG. 13—"BALLOON" LAY-OUT

But although rail brakes, quite apart from their high initial cost, must be considered to be ruled out where the modernisation of a

ladder type yard is under review, there are definite operational advantages to be derived from the power operation of the points. Records taken over periods of many years show that a surprisingly great amount of time, anything up to 35 per cent. of the twenty-four hours, is spent in correcting wrong shunts. In a non-mechanised yard this may occur through wrong operation of the points, through misreading of the siding numbers chalked on the wagons, or through individual vehicles running too closely behind one another for the pointsman to have time to throw the switches without risk of derailment. In some of the earliest hump yards constructed in this country the points were operated by compressed air; each turnout was individually controlled from push buttons in the signal cabin adjacent to the hump. But although after passing the king points only one other pair required to be operated a sharp lookout was necessary to judge the correct time for shifting, when, maybe, a second cut of wagons had commenced to descend the hump. Nowadays the experience gained with fully mechanised lay-outs is fortunately available when the modernisation of existing yards is being considered, and by the use of route switching the task of the signalmen can be made much less exacting; this has become a matter of great importance under black-out conditions, particularly when vital traffic has to be passed through during air raids.

The art of route switching was first developed in connection with fully mechanised yards, and in order to trace the stages by which the present systems have been attained it is necessary to consider the balloon type of lay-out for a moment. Fig. 13 illustrates a group of sixteen sidings arranged on this principle, where the first, second and third sets of diverging points are referred to as the "king," "queen" and "jack" points respectively. For the automatic setting up of routes the principle used in magazine train describers first suggested itself; apparatus employed for the indicating of first, second and third trains on the London Underground Railways was successfully adapted to hump yard conditions, so much so that it was possible to "store" in advance up to fifty-two routes. An operator, on receiving the card giving the list of cuts for a train about to be humped, could set up and store all the successive routes required, so that when humping commenced the points were automatically operated, each point setting being cancelled section by section, and the next immediately set up by track circuit control as the wagons passed through.

In actual application of this principle, however, it was found desirable to limit the purely automatic control to the king, queen and jack points, leaving the remaining eight pairs to be operated individually from the control cabin; these remoter points are not so often shifted, and with wagons following at less frequent intervals the operator can readily judge the correct time. The difficulty with this arrangement arises under conditions of bad visibility in fog, falling snow, or in the black-out; but shortly after the installation of the pioneer magazine storage route setting schemes the principle of relay interlocking came to the fore, primarily in connection with remote operation of power signalling equipment. With this principle as a basis a system of progression relay control was developed, which offered a very attractive alternative to the magazine storage system and which, on account of its compactness and reduced cost, could be applied to the automatic control, not only of the king, queen and jack points, but to the entire route for every siding. In so doing the storage feature is not included and each successive route has to be set up by the operator as the wagons pass over the hump. This system of progression relay control,

FIG. 14—"LADDER" TYPE HUMP MARSHALLING YARD

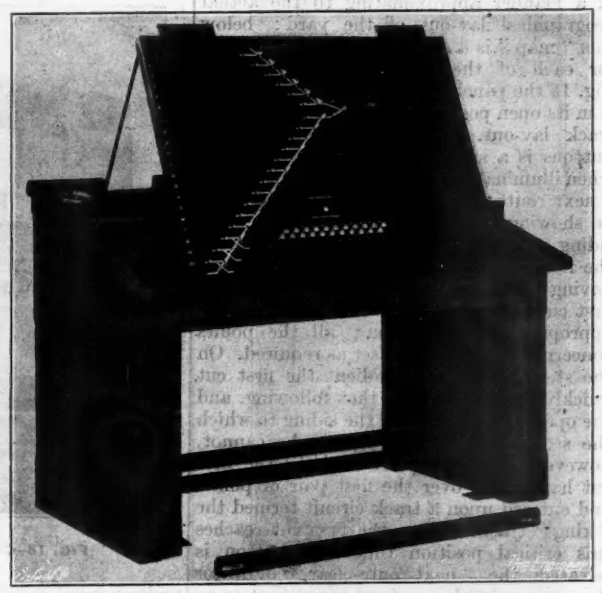


FIG. 15—CONTROL PANEL FOR "LADDER" TYPE YARD

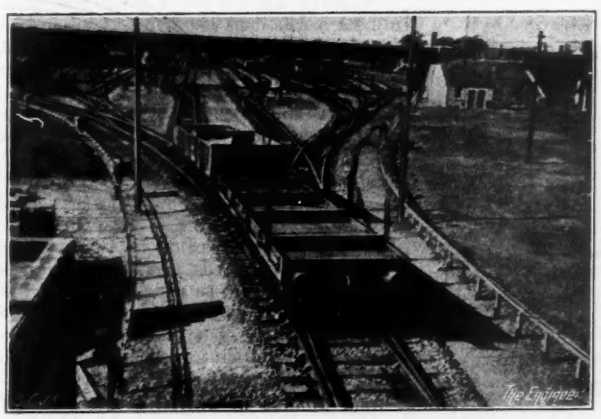


FIG. 16—"BALLOON" TYPE HUMP MARSHALLING YARD

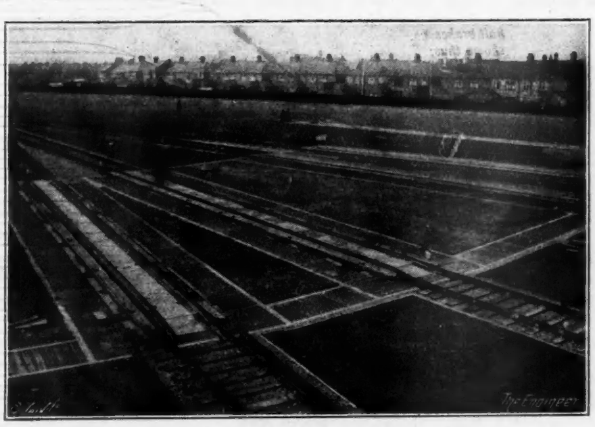


FIG. 17—RAIL BRAKES

although first designed for use with rail brakes in a balloon yard, has been applied most successfully to an existing yard laid out in ladder form. This installation has been completed since the outbreak of war, in conjunction with an important scheme of main line widening. A description of the working in this yard, which is illustrated in Fig. 14, will make clear the operating principles involved.

In the control room is a panel, shown in Fig. 15, on which the sidings are represented in a manner approximating to the actual geographical lay-out of the yard; below this "map" is a series of push buttons, one for each of the twenty-one sidings. In Fig. 15 the panel portion of the control desk is in its open position, the better to show the track lay-out. Above the route setting buttons is a small visual indication, which when illuminated and showing green, signifies "next route clear." This green light must be showing before humping is begun. The siding numbers are chalked prominently on the fronts of the wagons, and the operator, having duly observed the destination of the first cut passing over the hump, presses the appropriate route button; all the points concerned are thereupon set as required. On the steep descending gradient the first cut quickly runs away from that following, and the operator can then see the siding to which the second cut must be sent; he cannot, however, set the next route until the first cut has passed over the first pair of points and entered upon a track circuit termed the "king" track. When the first cut reaches this critical position the route button is released, the "next-route-clear" indicator shows green, and, as a further notification to the operator to set the route for the second cut, a buzzer is sounded momentarily; and as humping of the entire train progresses the routes are set for each cut, as the operator receives the simultaneous audible and visual indication that the immediately preceding cut has reached the king track.

It will be appreciated that in the practical working out of such a scheme a variety of safeguards have to be included against faulty manipulation of the control buttons and against the chance of a derailment while humping is in progress. Against the first a positive mechanical interlock is provided, which prevents more than one route setting button being depressed at a time; also, after depression each button is latched down and not released until the "next-route-clear" signal is received. There are occasions, too, when owing to a wrong shunt or to the derailment of a wagon it is necessary to stop humping and to cancel all routes set up; automatic point operation may be stopped by the depressing of a cancelling button, while a signal to the driver of the humping engine is given by means of a day colour light signal placed at the crest of the hump. After route switching has been cancelled individual points may be operated as desired by thumb switches, situated on the control panel, at the correct geographical position of the points on the track diagram.

The time available for operating points under normal working, when cuts are following each other rapidly from the crest of the hump, is necessarily small, and particular attention has had to be given to the designing of apparatus with the quickest possible response to the control current. In this a goods yard has, fortunately, one inherent advantage over a lay-out through which mixed traffic passes; since there is no conveyance of passengers, there is no need for the facing points to be bolted. In the yard under consideration the electro-pneumatic cylinders for point operation are coupled directly to the stretcher bars, resulting in extremely rapid throwing of the switches. Furthermore, with goods traffic only being handled the track circuits can be normally de-energised, with the circuit made only when a wagon enters the particular section; this, of course, is exactly the opposite to the basic principle of ordinary track circuiting, wherein the outstanding safety feature provides for a "line blocked" indication in case of a current failure. But in a marshalling yard the advantages to be gained more than outweigh any chances of a derailment; the relay of a normally de-energised track circuit will, on a wagon entering the section, pick up and close its front contacts much more rapidly than the relay of the usual type of track circuit will drop away and close its back contacts and the split-second gained at each operation is worth having. Speed is of paramount importance in the control of hump yard points, and what is achieved by use of these special methods may be judged by one example of performance in ordinary everyday service; under individual operation, by thumb switch from the panel, a pair of points can be thrown in a little under half a second from the operation of the switch.

FIG. 18—CONTROL TOWER

For new yards, whether mechanised or not, the balloon type of lay-out is generally preferred. Fig. 16 illustrates a hump yard where the points are power operated, but including no rail brakes. From the traffic working point of view rail brakes are a very attractive proposition, for they not only enable a considerable reduction in man power to be effected, but cause less damage to goods and rolling stock, and give improved working in bad weather when the mobility of shunters may be seriously affected. But as compared with the relatively simple apparatus for automatic route setting their cost is high. For the construction of an entirely new English yard and its equipment with four rail brakes and automatic point setting the estimated cost was £285,000; this figure related to conditions about ten years ago, but when the cost of the permanent way is deducted, and that of building a control tower, a typical example of which is illustrated in Fig. 18, a figure remains which gives an approximate idea of what an installation of rail brakes is likely to involve.

In developing the art of freight train classification in yards equipped with rail brakes it has been found possible to use far less brake units than are installed in American yards having the same number of sidings. The general principle having been originated across the Atlantic, one naturally tends to study the details of yards in the U.S.A. equipped with rail brakes. In one of the earliest American installations a hump lay-out serving a group of sixty sidings was provided with no less than 121 rail brakes, and although subsequent experience has shown how it is possible to dispense with a great number of these, by modification of the track lay-out and the gradients, one still finds as many as twenty-four brakes in a modern yard of forty sidings laid out on the balloon principle. In England the four rail brakes

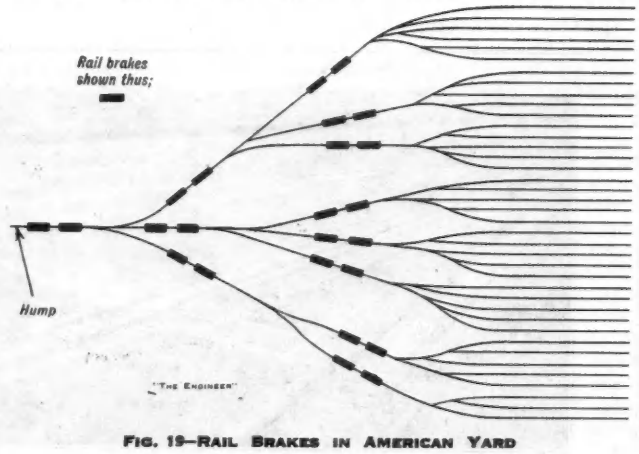


FIG. 19—RAIL BRAKES IN AMERICAN YARD

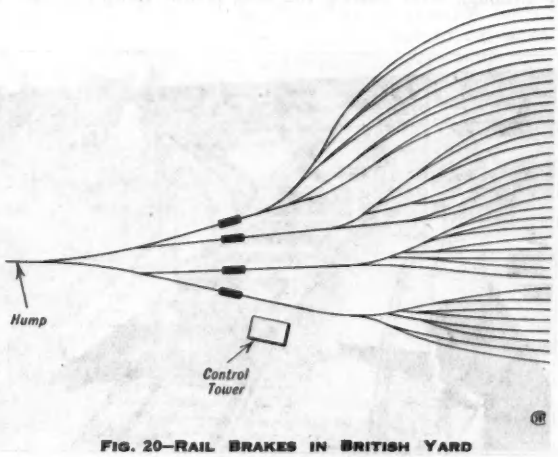


FIG. 20—RAIL BRAKES IN BRITISH YARD

shown in the photograph reproduced in Fig. 17 control the speed of wagons entering a yard of thirty sidings. But while this disparity between English and American hump yard equipment can be attributed largely to the great difference in weight of individual loads to be braked, there is a growing tendency in this country to use wagons of higher capacity. Even now a free-running cut can be something of a problem, and with only one opportunity of checking its speed the brake application is necessarily a severe one. Less wear and tear to the brakes themselves and to rolling stock, and less damage to freight, is likely to occur with two or more gentler brake applications, and as giving some indication of what may be found necessary in future British installations the lay-out of a typical modern American yard, as shown in Fig. 19, forms an interesting study.

It will be seen that the rail brake units are installed in pairs, thus giving increased flexibility of control using one or both for retarding the descending cuts. The track from the hump branches into three, instead of the four roads customary in Great Britain. Each of these three roads has its own pair of rail brakes, beyond which come the next group of diverging points, followed by a third pair of brakes. Thus each cut passes over six brake units. The companion diagram, Fig. 20, shows the lay-out of a recently equipped British yard with thirty-five tracks, against thirty-nine in the American example; in offering this lay-out for comparative study it should, however, be mentioned that the yard in question is used mainly for the classification of empty coal wagons *en route* to an extensive colliery district, and with a general average of about two wagons per cut the loads to be braked are not very large. At another British yard dealing with somewhat similar traffic only two rail brakes are used to control the entry to a group of forty-two sidings.

In this article, while describing work that has actually been done, opportunity has been taken to indicate certain directions in which further economies and improvements might be effected, these suggestions being based on actual operating experience with plants in regular service. Among these the suggestion that further installations of rail brakes may shortly become necessary in this country, for dealing with traffic directly connected with the war, might on first thoughts seem to be based upon an exaggerated view of likely railway conditions. But as the war progresses the problem of man power will necessarily become more acute, and it may well be that the cost of installing, say, four rail brakes will be justified on the grounds that it will release 100 or so skilled brakesmen for service elsewhere.

Non-Metallic Chemical Plant

By A. E. WILLIAMS, F.C.S.

No. II

(Continued from page 6, July 3rd)

"VITREOSIL"

"VITREOSIL," or vitreous silica, is silica made by the patented processes of the Thermal Syndicate, Ltd., Wallsend. The prepared material is a homogeneous and uniform product of over 99·8 per cent. pure silica and possesses many properties which make it valuable as a material for chemical plant construction. Originally "Vitreosil" was applied chiefly to the making of relatively small pieces of apparatus such as are used in laboratories, but as its properties became more widely known and manufacturing technique improved it was possible to construct larger apparatus for use in industry. "Vitreosil" may be either translucent, with a glazed, satin or sand surface, as required; or transparent, where it has usually a glazed surface. The transparent variety is used for the making of sight glasses, sight tubes, &c., where resistance to heat and corrosion is required, and its quality is such that it can be used for optical purposes, such as the construction of lenses and prisms. Because it has the property of transmitting ultra-violet and infra-red rays the transparent material is valuable in connection with radio therapeutic, monochromatic and ultra-violet light apparatus. But for chemical plant construction, where transparency is not of importance, the translucent variety is normally used. "Vitreosil" is not affected by the majority of chemicals, exceptions being hydrofluoric acid and strong caustic alkalies. Well-known inorganic acids, such as sulphuric, nitric and hydrochloric acids, have no action on it at temperatures up to 100 deg. Cent., while it is impermeable to gases under ordinary pressures, even at elevated temperatures, with the exception of helium and hydrogen. "Vitreosil" has a very low coefficient of expansion, being about one-seventeenth that of glass. Its relative linear expansion as compared with that of other well-known materials is shown in the following table:—

	Per deg. Cent.
"Vitreosil"	0·00000054
Nickel steel (Invar, 36 per cent. Ni)	0·0000009
Porcelain	0·00000316
Glass (chemical)	0·0000032
Glass (Jena)	0·0000057

Because of this low coefficient of expansion "Vitreosil" is capable of withstanding sudden and extreme temperature changes without damage. In fact, red-hot pieces of the material may be plunged into cold water without cracking or injury. It is also practically free from thermal hysteresis, unlike most other solids which undergo permanent deformation when subjected to a temperature cycle. The melting point of "Vitreosil" is not sharply defined, for an appreciable softening takes place at about 1500 deg. Cent., but it may be taken as being very similar to that of platinum, between 1700 deg. and 1800 deg. Cent. When subjected for long periods to high temperatures it has a tendency to become brittle and to suffer a change in its physical characteristics, which change is due to its reverting from the vitreous to the crystalline state. This reversion, or devitrification of the material has been investigated by the National Physical Laboratory, and the results of the investigation are of great interest to users of the material for high-temperature work. The N.P.L. report may be summarised as follows:—"In general the loss of strength hardly commenced at 1120 deg. Cent.; at 1188 deg. Cent. it existed, but was not very serious even after eight hours' heating; but four hours' heating at 1350 deg. Cent. produced a reduction of 40 to 50 per cent. in the strength, thus showing that the rate of loss of strength increases very rapidly as the temperature rises." The material can, however, be used indefinitely at temperatures up to 1350 deg. Cent. provided the temperature is never allowed to drop below 300 deg. Cent. It may therefore

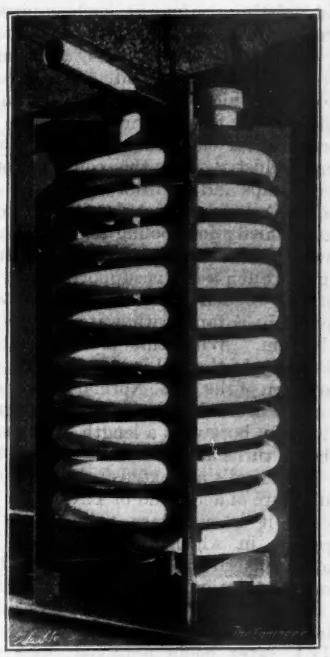


FIG. 5—COOLING COIL OF "VITREOSIL"

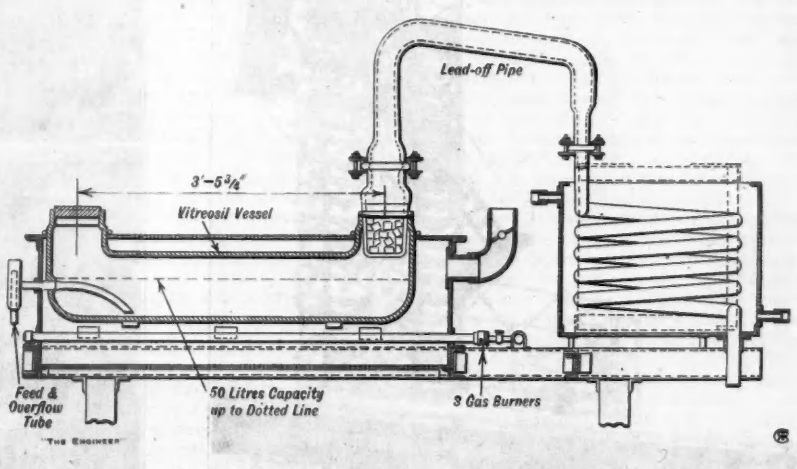


FIG. 6—DISTILLATION SET MADE OF "VITREOSIL"

be used for sighting tubes for optical pyrometers for continuously operated furnaces and for protection tubes for thermo-couples. Its heat-resisting properties are made use of in the iron and steel industry, examples being in the construction of pipes of rectangular section for use as bearer bars in the hot zone of a sheet metal annealing furnace, and special muffles for the bright annealing of wires and similar work. In chemical works "Vitreosil" is used in the construction of a wide variety of acid-resisting equipment, such as pipes for hot gases and acids, condensing and cooling coils, hydrochloric acid plants, and concentrators for sulphuric acid. Quite recent developments include the making of immersion heaters for the electrical heating of acid liquors used in chemical works and in the plating industry, and the construction of ejector pumps and air lifts.

Coils.—Coils constructed of "Vitreosil" are used chiefly for cooling and condensing, an example of a cooling coil being illustrated in Fig. 5. Such a coil is supported by a teak or other wooden frame, and the whole immersed in a tank with water entering at the bottom. With this arrangement the socket entry to the coil is preferably fixed to the top turn of the coil. Normal sizes of these coils range from 1in. bore with a length of 20ft., to 3in. bore with a length of 125ft., the number of turns in the latter size of coil being 14½. These coils are extensively used in the manufacture of acids and of T.N.T. In some processes it is necessary to heat the coil externally, in which case the teak wood frame is replaced by one of cast iron. Fig. 6 shows a distillation set, constructed entirely of "Vitreosil," and by reason of its chemical inertness this material permits of a very pure distilled water being obtained, such as is required in the preparation of luminescent compounds for electric discharge lighting. The raw water is boiled, by gas burners, in the retort on the left, which is of flat form and so presents more heating surface than a balloon type retort. It may be operated continuously as it is fitted with a constant-level feed arrangement. Any spray coming over with the vapour is trapped by the packing in the outlet to the condensing coil. All joints are ground, thus dispensing with cements. The coil has a bore of 1⅜in. and is 26ft. long. This still has an output of 25lb. of distilled water per hour, with a gas consumption of 140 cubic feet per hour, equal to 475 B.Th.U. per cubic foot. As it is arranged for

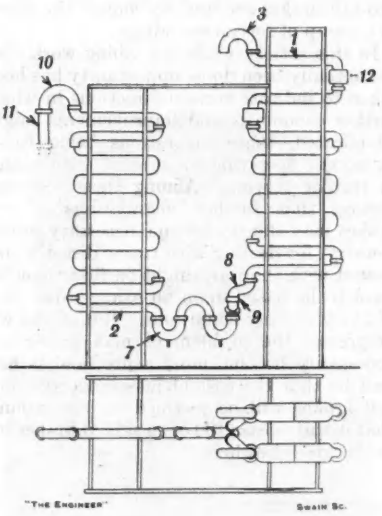


FIG. 7—ARRANGEMENT OF "S" BEND PIPES

continuous operation the still can be applied to the redistillation of acids, &c., and, when necessary, a separate feed tube can be fitted to feed at the top left-hand side of the retort, when the constant-level tube will serve as the purge overflow. To give a greater output or for fractionating liquids a battery of these stills can be arranged, cascade fashion, in a suitable setting to feed from one to the other.

Hydrochloric Acid Plant.—Other forms of coolers and condensers are made up in sections, each section consisting of an S-bend pipe, arranged vertically one above the other and cooled either by atmosphere or by drip water. The bore of such a cooler may range between 2in. and 10in., the corresponding lengths of the S-bend pipes being from 3½ft. to 6½ft. The diagram Fig. 7 illustrates the method of arranging the S-bend pipes to form a cooling and absorption system in a hydrochloric acid plant. This acid may be manufactured by heating together common salt and sulphuric acid, which mixture emits hydrochloric acid in the gaseous state and this must be absorbed by water to give the commercial acid. The straight air-cooled pipes 11 (Fig. 7) bring the hot gases from the reaction chamber and in doing so effect an appreciable cooling of the gases. The bend 10 connects the straight length of piping to the series of S-bend cooling pipes 2, which are water cooled and may be wrapped in hessian to direct the water supply. In the trap 7 accumulate small proportions of hydrochloric acid in the impure state, which is run off periodically. The gas stream passes on, through the connecting pieces 8 and 9, into water-cooled absorber columns, and the bend 3 connects with a scrubbing tower of the same material, from whence the weak acid obtained may be passed again into the absorbers. Intermediate packed towers 12 may be employed for handling gases of low concentration to improve their contact with the absorbent.

A plant of this description is shown in Fig. 8. The absorber columns are built up of S-bend pieces in a manner similar to the S-bend pipes, but the absorbers differ from the pipes, in that they have a rectangular body with circular ends. Near the spigot end of each absorber is a dam which retains a portion of the absorbing liquid to present a larger surface area to the gas to be absorbed. The supporting structure for the "Vitreosil" equipment is usually of light steel sections, which may be protected in the following

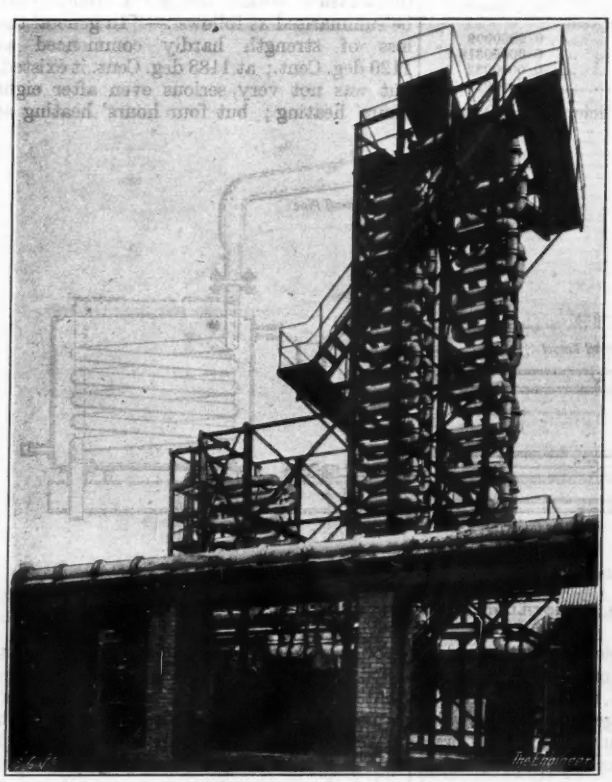


FIG. 8—HYDROCHLORIC ACID PLANT

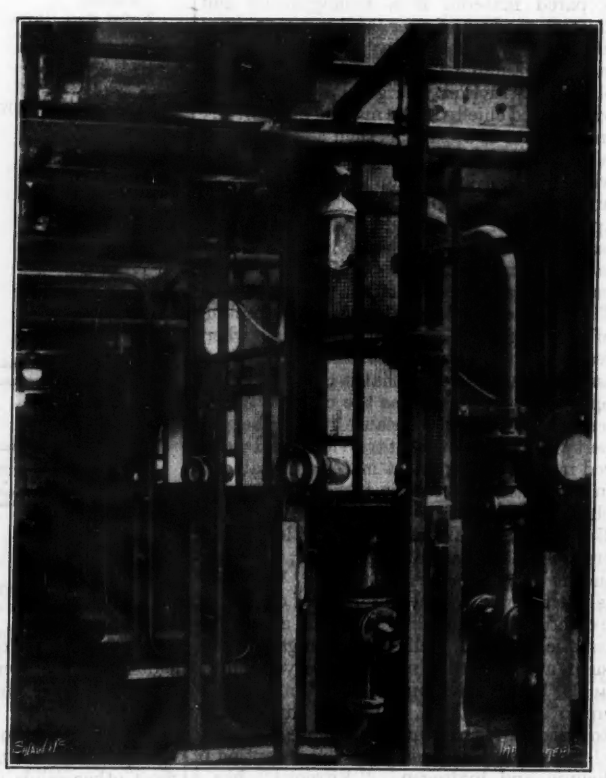


FIG. 9—CHLORINE AND HYDROGEN COMBUSTION CHAMBERS

manner. The steel work is first cleared of scale before applying a coat of either good-quality ferric oxide or red lead paint. Then two coats of chlorinated rubber paint are applied, a coat of this paint being given every two years afterwards.

Another method of making hydrochloric acid is by synthesis, that is by the combustion of hydrogen and chlorine, which gives a much purer product than the former method. For a synthetic acid plant of this nature the material used has to withstand both heat and the exceptional corrosive influence of the nascent acid gas, and "Vitreosil" has been found to be a satisfactory material for the job. The cooling and absorbing system of a synthetic hydrochloric acid plant is in design similar to the one previously described, the main difference being that the reaction unit for salt and sulphuric acid is replaced by a combustion chamber and special burners. In general these burners for chlorine and

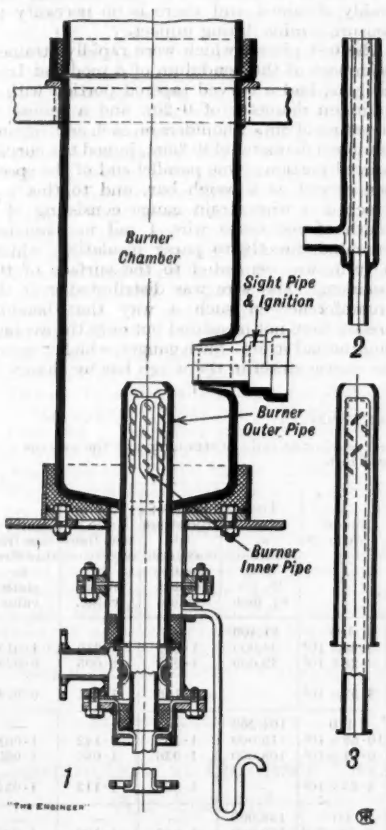


FIG. 10—BURNERS FOR HYDROGEN AND CHLORINE

hydrogen may be described as of the forced draught type. Fig. 10 illustrates three such burners, each type comprising two concentric tubes, an inner one for chlorine and an outer one for hydrogen. No. 1 burner is shown connected to a combustion chamber and this burner will deal with 275 lb. of chlorine per hour, the figures for the smaller patterns, 2 and 3 burners, being 70 lb. and 65 lb. respectively. In the No. 2 type burner the tubes are fused together as a single unit and this arrangement can be applied to burners of smaller capacities. A battery of these combustion chambers, arranged as in No. 1, Fig. 10, is shown in Fig. 9 installed in a works. It is, of course, permissible to use steel piping for hydrogen, &c., but all the plant coming into contact with the acid, including the burners, is of "Vitreosil." The sight glass of this material will be noted in front of each combustion chamber. These windows are especially useful because of the high transmission efficiency of this material to radiation. They are also suitable for high-pressure equipment. For example, Poulter (*Phys. Rev.*, 1932, 40, 860) has described the fixing of such windows into apparatus to withstand 30,000 atmospheres internal pressure.

(To be continued)

The Engineering Approach*

By Lieut.-Commander R. E. W. HARRISON, U.S.N.R.

METHODICAL thought processes are at present denied to many people in all walks of life, the result being seen in reliance on emotionalism, hunches, incomplete analysis, theatricalism, and the use of just plain ordinary sloppily incomplete data. All human problems, whether they be the engineering design of a bridge, the defeating of an opposing army, the destruction of enemy ships, or the solution of a simple task such as the selection of a person for promotion, yield to analytical treatment. This article is a plea for the teaching of methods of analysis toall students as a part of their formal education.

The attitude taken by some college professors, that by the time the student has reached college age he has already learned how to think, is dead wrong, and the answer to this is that those professors themselves have never made use of methodical quantitative analysis to anything other than the routine educational tasks in physics, geometry, and mathematics.

All life yields to analysis, and the reason we have so many unanswered queries is that we do not know how to use the mental tools which now lay close at hand, available to anyone with the mental strength to use them.

Sound judgment, as applied to all things in respect to which judgment is called for, should invariably be analytically approached, with the conclusion coolly and calmly arrived at, if the results are to be truly judicial. The ability to achieve this end is desired by every person of discrimination. Unfortunately, relatively few people have been trained, or have taken the trouble to train themselves, in the few simple, basic, quickly applied methods of anaysis which are available for immediate use to any person with an elementary education. The charge can be made and upheld that there is a deficiency in any educational system, no matter how adequate otherwise, which fails to teach a student how he can so arrange his windows of intellectual enlightenment that the pattern of light focusses clearly on a conclusion which is self-evident, inescapable, logical, and wise.

An indecisive person is a liability rather than an asset in any organisation, irrespective of whether the organisation be an army in the field, a division of battleships, a factory, a federal government, or even that smallest unit of organisation, a family of human beings. Probably one of the most richly rewarded fields of psycho-analysis lies in the diagnosis and supplying of mental formulæ which will provide a life line permitting the indecisive person to make decisions in which he has confidence and conviction.

METHOD OF THOUGHT

With an accepted pattern for attack on all problems, tried out and proven effective, the average person can at once pick out an appropriate trial analyses chart, fill in the factors, apply the rules of exception and weighting, and automatically and systematically arrive at a conclusion which is logical, legal, equitable, and lasting.

IMAGINATION NEEDED TO PROVIDE LIST OF FACTORS

Education is the great provider of the "windows" through which the light of other people's experiences may be brought to bear upon one's own particular problems. Education may be formal, informal, technical, non-technical; can, in fact, be most anything so long as it is broad and has been developed through the "seeing eye" of the receptionist without prejudices borne in, plus a retentive memory. Obviously, the broader the education, the more windows through which the light can be admitted. It is a worth-while matter of record which we may credit to to-day's educational procedures that formal education now aims at providing the student with a good kit of "know how," "know where to look," and "know people," and the proper references, rather than the provision of such isolated relatively useless data as the cosine of this or that angle, the chemical constituents of this or that mineral, at the expense of the knowledge of where to get the proper data quickly and accurately, and how to apply it once it has been obtained.

How often is the thought thrust on the adult mind that the formal education of our youth has, in most cases, neglected to include proper grounding in the basic principles from which there is no escape for anyone. It is surprising to-day to encounter so many technicians who have achieved such success as has been theirs, armed with a kit of tools, dull of edge and incapable of easy use, unco-ordinated, and rusty from disuse.

Invariably, at the head of any large organisation there is an exponent of the application of the few basic principles which run the activities of that organisation. If further proof of this thesis be needed, it lies in the fact that all the truly great individuals of all times have had simple methodical thought processes which have adequately upheld the mission of their minds on those occasions when they have successfully achieved that which they most desired, often in the face of seemingly insurmountable difficulties.

AVAILABLE TIME

Just as the timid recruit requires much time, much applied patience, repeated instruction in the creation and boosting of his morale, and the availability of a good rifle and fine weather before he can begin to make a score on the rifle range, so the average person requires a host of factors operating in his favour, before he can attain results in the mental field. That which appears to be super-mental agility in some one person often is simply the exposition of a training formula patiently imparted by a competent instructor.

Why it should ever have been thought that one might possess mental agility without organised preparation and practice, is another demonstration of a short-sighted unwillingness or inability to think in a trained way which characterises many a youth as he bravely steps forth into the cruel waiting world from out of the hands of his equally or even more muddled preceptors. If our professors and other educators could perceptively peruse, in reverse order, the vista of their own lives, they would have a much better appreciation of the circumstances and factors which taught them how to learn at the time when they first struggled with the problems with which they now bedevil their charges. This is all the more apparent when one recalls how even the boxing instructor invariably commences his instructional remarks by impressing on the student that failure to take such and such a guard at some time or other results in taking a fatal wallop. Reverting to the educational theme, it is surprising that so little of modern history is enlightened by authentic dissertations on past circumstances which have made the situation of to-day inevitable. It might be said that the tendency of practically all human beings is to be mentally lazy and emotional, rather than mentally alert and factually analytical. The follower of hunches is the demonstration *par excellence* of to-day's mental processes. History, however, fails to relate that the followers of hunches have, so far, beaten the analyst—that they have accumulated large fortunes on the race track, the stock exchange, or even in mundane business. That so many people play their hunches rather than their judgment is additional proof, if that indeed be needed, that mental laziness and the conceit which prompts

* From the *Journal* of the American Society of Naval Engineers.—February, 1942.

faith in the starry-eyed goddess of fickle fortune is but another phase of auto-intoxication.

UNIVERSAL APPLICATION

There will always be those rugged individuals who oppose standardisation of anything, in the honest belief that standardisation freezes initiative, and that standardisation of methods of thought analyses will in a short time atrophy the brain. Fortunately, these poor people are in the minority, and although they make up in volume with their howls of protest for their lack of judicial merit, they usually go down to utter defeat before the insatiable craving of the healthy young mind forever seeking a reliable and trusted ladder on which he may climb to greater heights of independent thinking in the shortest time and with the least effort.

The mission of this article is a plea for a more analytical approach to all of our mutual problems, whether they be professional or lay in nature, domestic or foreign, religious or social; whether they concern our health, our politics, or our price.

To those who devote adequate thought to this subject it is a matter of surprise that the philosophy of logic has so far found so little favour among those whose real task is to teach us "how to think." Perhaps it is that our preceptors fear the effect on the student mind when the time-honoured opaque crusts of prejudice, out-worn theories based on incomplete data, hit-or-miss methods and motivations based on hunches, are at last broken down and revealed in the light of their true worth. Possibly new methods of imparting knowledge are required.

CONCLUSION

Contemplation from the philosophic viewpoint alone, insufficiently stirs the imagination to proper appreciation of quantitative analysis as an everyday tool for the hands of "John Doe." In the beginning it takes much mental strength to compel the reluctant mind to arrange its data on cause and effect in an orderly way, but once the technique has been acquired, the practice loses all its terrors, and in a short time there even occurs a warm feeling of beneficent pride after a good piece of practical analysis has been accomplished, in much the same way we all, in our pre-school days, experienced a sense of beatification when nurse commended us for a good job done in obeying one of the primary laws of the nursery.

In other words, that which is advocated is an orderly method of thought, a habit which can be just as easily acquired as any of the other habits which make up the trivia and minutia of everyday life.

"Mr. Milquetoast" normally shuns a discussion on current national economic problems unless sure of the intellectual inferiority of his audience. "Mrs. Milquetoast" issues no rash challenges to mortal intellectual combat with fellow-members of the Mothers' Club. Why? Because they both lack the conviction and poise inseparable from the analytical mind.

To begin with, the suggestion is offered that the subject's normal mental processes be relied on for the everyday affairs of life, and quantitative analysis be reserved only for the more important questions. Gradually, the sure-fire results and fascinating processes of constructive analytical thought will enchant the mind of even the dullest operator, and so, in course of time, there will be achieved that ideal of democracy, a clear-thinking, independently minded public.

Concurrently, our analytically minded public will see with new eyes, and will hear with new ears, the gaudily deceptive advertising and clap trap of many of the radio programmes. They will also be able to defeat the man at the county fair who now beats them to what appears to be a cinch—they cannot pick out the answer to "Under which shell does the dime repose?" How, you ask, will they beat it? Why, by simply walking away and perhaps wasting their money on something else.

These thoughts are a plea for the application of quantitative analysis to the problems of everyday life. Far be it from the author's intention to suggest the use of quantitative analysis in the evaluation of matters which are essentially spiritual, artistic, or matters of affection. In cases of such nature we must evaluate the intangibles, and that is not easy, but also not impossible.

If any master military mind opines that time, place, and opportunity are always lacking wherewith and wherein to make an analysis of a projected five-paragraph operation order, there is offered in refutation of this theory the proof that every unsuccessful military action has upon subsequent analysis been shown to be faulty in concept simply because the analysis was made after and not before the order was issued.

There is no such thing as mathematical certainty in any phase of this or the next life, but the law of averages inspires the dictum of the gods, and until we are blessed with divine inspiration we had better make good and systematic use of the tools which are always to be found close at hand.

A case has been presented here which merits attention, especially in this time of stress and strain. There never has been an occasion when our decisions were of greater potency—this plea is that we make them good and sound in every way.

High-Speed Tensile Tests

REFERENCE has been made in THE METALLURGIST to Professor A. V. de Forest's lecture on "Some Complexities of Impact Strength," and to the strain gauge devised by him for the measurement of rapidly applied stresses.* An application of this gauge to the determination of the tensile properties of materials subjected to rapidly applied loads is contained in a paper on "Rapid Tension Tests Using the Two-load Method," by A. V. de Forest, C. W. MacGregor, and A. R. Anderson.†

In this work the true stress-strain curves are reported, not the ordinary load-extension diagram of stresses based on the original area and strains based on the original length. The construction of such curves, while comparatively simple for the slow rates of loading customarily used in the tension test, presents certain difficulties for tensile impact, in that both loads and diameters are required throughout the test. To make it possible to obtain the true stress-strain diagram from yield to fracture in the tensile impact test, the two-load method suggested some time ago by C. W. MacGregor‡ was employed.

Briefly this method consists in the scribing of a properly tapered tensile specimen, by means of a diamond tool, with fine circumferential scratches at different positions along its length, measuring the diameters at these positions before and after the test, and constructing the true stress-strain curve. The maximum load and the load at fracture must be known. Then the maximum load divided by the area at successive positions along the bar gives the true stresses which may be plotted as a function of the corresponding strains from the initial yielding to the maximum load. The remaining portion, from the maximum load to the point of fracture, is obtained by dividing the load at the fracture by the fractured area, plotting this at the corresponding value of strain and drawing a straight line from this point as a tangent to the first part of the curve. It has been checked experimentally that the curve so constructed is the true stress-strain curve from yield to fracture. The method lends itself particularly well to the impact problem, since the maximum and fracture loads are readily obtained and there is no necessity to measure strains during impact.

The test pieces, which were rapidly strained by impact of the pendulum of a modified Izod machine, had a curved tapered portion with a minimum diameter of 0·2in. and a radius of curvature of 8in. Shoulders on each end, having a uniform diameter of 0·35in., joined the curved tapered portion. One parallel end of the specimen served as a weigh bar, and to this was attached a wire strain gauge consisting of a length of resistance wire 1 mil in diameter, cemented directly to paper insulation, which, in turn, was cemented to the surface of the specimen. The wire was distributed over the circumference in such a way that bending stresses were not measured but only the average longitudinal strain. Such gauges, which measure the elastic strain in the weigh bar by change in electrical resistance of the wire, are found to show no hysteresis or change due to speed effect up to 30,000 alternations of stress per second. The use of such gauges, in which changes of resistance can be amplified and recorded on a suitably calibrated oscillograph, has been described by Professor de Forest.

The load-time curve was obtained from the oscillogram, the maximum load and load at fracture were ascertained from the curve, the diameters before and after the test were measured along the specimen by means of a special dial gauge and clamp attached to a lathe comparator, and the true stress-strain

Summary of Test Results

Giving the static test, the high-speed tests at the highest and lowest rates of straining, and the average of the high-speed tests

Material.	Composition and treatment.	Average true rate of strain, in./in./sec.	Speed ratio, $\frac{v}{v_0}$	True stress at maximum load, lb. per sq. inch.	Ratio of true stress at maximum load to static value.	Ratio of true fracture stress to static value.	Ratio of true fracture strain to static value.
S.A.E. 1112	C, 0·08–0·16; Mn, 0·6–0·9; S, 0·1–0·2; P, 0·09–0·13. Annealed	903×10^{-6}	1·0	81,400	—	—	—
	1 h. at 1650 deg. Fah. and slowly cooled	482	$5\cdot34\times10^{5}$	98,000	1·290	1·230	1·015
		206	$2\cdot28\times10^{5}$	89,000	1·092	1·005	0·924
	Average of eight high-speed tests	—	$3\cdot52\times10^{5}$	—	1·140	1·121	0·974
S.A.E. 1045	C, 0·4–0·5; Mn, 0·6–0·9; S (max.), 0·055; P (max.), 0·045.	335×10^{-6}	1·0	104,200	—	—	—
	Annealed 1 h. at 1450 deg. Fah. and slowly cooled	358	$10\cdot69\times10^{5}$	115,000	1·102	1·142	1·001
		222	$6\cdot61\times10^{5}$	108,000	1·036	1·085	1·060
	Average of two high-speed tests...	—	$8\cdot65\times10^{5}$	—	1·069	1·113	1·031
S.A.E. 3140	C, 0·35–0·45; Mn, 0·6–0·9; Ni, 1·0–1·5; Cr, 0·45–0·75; S (max.), 0·05; P (max.), 0·04.	387×10^{-6}	1·0	158,000	—	—	—
		224×10^{-6}	$5\cdot79\times10^{5}$	158,000	1·000	1·100	1·083
		156×10^{-6}	$4\cdot06\times10^{5}$	156,000	0·987	1·085	1·072
	Hot rolled; tested as received	470	$12\cdot2\times10^{5}$	180,000	1·140	1·180	1·172
		178	$4\cdot60\times10^{5}$	170,000	1·075	1·060	1·060
	Average of six high-speed tests ...	—	$8\cdot12\times10^{5}$	—	1·080	1·116	1·102
Brass	Cu, 62; Zn, 35; Pb, 3. Half-hard, annealed 1 hr. at 785 deg. Fah. and slowly cooled	422×10^{-6}	1·0	74,500	—	—	—
		186	$4\cdot42\times10^{5}$	85,000	1·140	1·485	1·226
		196	$4\cdot66\times10^{5}$	86,000	1·154	1·345	1·247
	Average of three high-speed tests	—	$4\cdot51\times10^{5}$	—	1·149	1·406	1·233

* THE METALLURGIST, December, 1941, page 41; *Metals Technology*, August, 1941, Technical Paper 1341.

† *Metals Technology*, December, 1941, Technical Paper 1393.

‡ *Journal of Applied Mechanics*, 1939, 6, 156.

curves constructed by the two-load method already described. The materials tested and typical test results are given in the accompanying table. As might be expected from previous work, the brass shows the greatest speed effect and the nickel-chromium steel the least. Static tests were carried out at different speeds for the different materials, times varying from 15 min. for one of the S.A.E. 3140 specimens to 40 min. for the S.A.E. 1045 steel. The dynamic tests varied from an average time value of 0·00245 sec. for S.A.E. 3140 to 0·00443 sec. for annealed brass. The corresponding values in the table are rates of strain in inches per inch per second, and the speed ratios are the ratios of average true rates of strain in impact and in the static test. Slight variations in this ratio make little difference. It appeared that the ratios might be varied as much as 10 : 1 without noticeable effect.

The table shows that a speed ratio of $3{\cdot}52\times10^5$ produces an average increase of 14·0 per cent. in the true stress at the maximum load and 12·1 per cent. in the true stress at fracture in the free-cutting mild steel. In the medium carbon steel the increases were 6·9 and 11·3 per cent. for a speed ratio of $8{\cdot}65\times10^5$. The low nickel-chromium steel shows an increase of 8 and 11·6 per cent. and the brass of 14·9 and 40·6 per cent. in the true stresses corresponding to the maximum and fracture loads. Meanwhile, the true fracture strains were increased by impact loading in every case except that of the free-cutting mild steel. In addition to the data given in the table, the form of the full stress-strain curves gives some indication of the effect of very rapid loading on the yield stress. The curves for static and impact loading of S.A.E. 1045 and 3140 are almost coincident at their yield points, viz., 50,000 lb. and 100,000 lb. per square inch respectively. The yield point of S.A.E. 1112 was about 40,000 lb. per square inch with static loading and 55,000 lb. per square inch under dynamic loading, while the brass also showed a difference, the static value being about 25,000 lb. and the dynamic value about 35,000 lb. per square inch. The effect of rate of loading on yield point is therefore much more pronounced in the softer than in the harder materials.

This paper is of importance in that it describes a promising method of investigating one of the most important problems in the design of structures and machine parts subject to rapidly applied loads, and the results reported are in themselves of considerable interest, as they indicate that the fundamental stress-strain relations of a variety of materials are not detrimentally affected by increasing the rate of straining in the ratio of approximately a million to one.

Construction at Quonset Naval Air Station*

By RAYMOND V. MILLER†

QUONSET POINT (GENERAL AND GEOGRAPHICAL)

QUONSET POINT is a cape on the west shore of Narrangansett Bay. Providence lies 20 miles up the bay to the north, and Newport, where the Navy has a War College, a training station and other important facilities, is 10 miles down the bay. The New Jamestown bridge to Conanicut Island is located a few miles south on the westerly side of the bay.

The Naval Air Station at Quonset Point will be a principal centre for the operation and repair of naval aircraft in this part of the United States. The appropriations have converted 800 acres of scrub-laden land, 360 reclaimed acres of bay and swamps, and 70 acres on Hope Island offshore into an Air Station that will be second to none. A brief description of this project will serve as a background for the discussion of the construction activities that follows.

The land purchased for the Quonset Point Naval Air Station was roughly in the form of a right triangle with both its base (running east and west) and its hypotenuse (running north-west-south-east) bordering on the bay. To bring it to a square about 1½ miles on a side the north-east corner was reclaimed from the bay by dredging.

The dredging job involved over 21,000,000 cubic yards of material. Some of the largest equipment in the country was used, and included four hydraulic dredgers and one dipper dredger. Nearly 12,000,000 yards of the hydraulic fill went into made land for runways, two-thirds of this quantity being pumped between August and Christmas. The depth of fill forming the runway site was 15ft. at the outer point. The material was pumped in behind a steel sheet pile bulkhead, 11,000ft. long, which was installed entirely with marine equipment. Some 9,000,000 yards of additional dredging were required to provide a 35ft. depth in a ship-turning basin, 3000ft. square, and in approach channels from the deep waters of the bay. Earth excavation amounted to over 3,000,000 cubic yards plus some additional rock work.

A view from the control tower of the operations building reveals an interesting panorama of the varied types of construction required at the Station. From this point may be seen landplane hangars and parking areas ; the large expanse of filled area on which has been constructed landplane runways ; the seaplane hangars ; concrete ramps and parking aprons for seaplanes ; a carrier pier extending out into the bay ; power and sewage disposal plants ; the industrial area, including aircraft storehouse, general storehouse, miscellaneous maintenance buildings, and an enormous assembly and repair shop building ; the personnel buildings consisting of barracks, mess halls, administration, dispensary, enlisted men's and officers' recreation buildings, cafeteria, cold storage, commissary and laundry buildings, and a defence housing project ; a colony of homes for officers and married enlisted men ; a network of roads ; and a railway connection paralleled by a main access road leading to the Station.

The history of the construction of these many features that comprise the Air Station is a record of expedited construction under generally adverse conditions. Work begun under the cost plus fixed-fee contract on July 16th, 1940. The contractors are the George A. Fuller Company and Merritt-Chapman and Scott Corporation. These two well-known firms operate jointly as a single unit. The results attained speak for themselves and reflect great credit on the resources and organising ability of both companies.

For the most part the basic construction work was undertaken and largely completed through about five months of winter weather, so that the Station could be placed in operation at the earliest possible date. On December 17th the first landplane alighted on a runway that was formerly Narragansett Bay.

At the beginning of construction only incomplete plans had been prepared. In fact, in the case of all the industrial structures a full set of plans was not available until completion of the buildings. Partial plans were submitted to steel companies for bids—upon a pound basis—on steel reinforcing and rolled sections. Fabrication was carried on as plans were finished. Lay-outs for plumbing, lighting, and other facilities were completed as the buildings went up.

Excavations and foundation work were initiated on units for which the delivery of structural steel and other building materials was assured. Early closing of these buildings permitted interior work to be carried on successfully through the winter months.

Plans for similar buildings erected at other bases were used in part. The general storehouse, for example, is patterned after a structure at Kodiak, Alaska, but more bays were added, foundations changed, &c. Other utility buildings were similarly redesigned in the draughting rooms at Quonset. Plans for the 1,000,000-dollar bulkhead, new pier, roads, runways, power plant, and various other units were prepared locally in their entirety.

Considerable study was required in the planning and co-ordinating of operations so that construction equipment could be successfully transferred from one project to another without serious delay or hold-up. Construction priority was given those buildings vitally needed for the storage of materials and naval operation equipment, in accordance with the general plan of obtaining a usable base at the earliest possible date.

The cost plus a fixed-fee form of contract was the only type that could bring the quick results desired without complete plans. The time required in advance of construction to prepare plans and specifications comprehensive enough for bidders to use in arriving at estimates and bids was thus saved. It is possible to initiate new projects promptly and push work energetically with only a general outline of the work to be done. Changes in requirements are met without the delay and paper work incident to supplemental agreements or change orders required under the competitive bidding form of contract.

In conformity with the Bureau's policy of utilising the services of outside engineers wherever they could be employed to advantage, Gibbs and Hill, Inc., of New York City, was engaged to design the power plant, the distributing systems, the laundry and cold storage buildings, and to modify as necessary the design of the assembly and repair shop. This firm preformed most of its work in a design office located on the site.

The administration building, cafeteria, dispensary, landplane hangars, barracks, quarters and recreation facilities for officers and enlisted men, as well as the gatehouse and fence, were designed by Albert Kahn, associated architects and engineers, Detroit, under the direction of the Bureau of Yards and Docks.

HIGHWAY AND RAILWAY CONSTRUCTION ON PEAT

For an establishment as large as Quonset, both rail and highway access are, of course, necessary, and the construction of these facilities was attended by some of the most interesting operations on the project.

Railhead is located at Davisville, about 3 miles west of the reservation on the New Haven Railroad, and the rail connection to the Station is on tangent for virtually the entire distance. The new access highway, 36ft. wide with 7ft. shoulders, parallels the railway for the first 1½ miles from the Station. It then swings wide to provide space for a clover-leaf intersection with the Boston Post Road, which has been carried over both rail and highway lines on concrete rigid frame bridges. The Post Road marks not only the halfway point between the Air Station and the railhead, but it is the dividing line between two completely different topographies. To the west the railway right-of-way passes through deep rock cut. To the east both highway and railway run through swamp land and peat bogs which required deep fill. Except for the extreme care required in blasting the locally famous "Devil's Foot Rock," which rose to a height of 20ft. immediately adjacent to the Post Road, the rock work was not unusual. Difficulties were met, however, in placing fill 70ft. wide and up to 30ft. in height over the peat.

Three principal peat deposits were encountered. One was 900ft. long and 25ft. deep ; the other two were each about 500ft. long and 8ft. to 10ft. deep. Based on careful cost estimates and some preliminary experimentation, it was decided to blast the deep deposit and excavate the two shallow ones.

In removing the peat by blasting, a section of fill about 100ft. long and some 20ft. high was first built out over the peat. The pipes were then driven through this fill into the peat and loaded with dynamite, which was subsequently detonated. The heavy surcharge of fill confined the energy of the explosion and caused the peat to be pushed out beyond the edge of the fill. The fill then settled into the depression formed.

Because of the difficulty experienced in driving pipes through the fill, a change of procedure was inaugurated after the first attempt, and thereafter they were driven into the peat ahead of the fill. Although filling operations displaced some of the pipes, this procedure proved more economical and equally satisfactory.

* Boston Society of Civil Engineers.

† Commander (Civil Engineer Corps), United States Navy.

For the shallower peat deposits draglines cast the peat beyond the limits of the fill area. In this operation fill was placed at the edge of the peat bog, thus providing a firm foundation from which to work. As fast as the peat was cast aside, more fill was added, which in turn pushed the remaining peat ahead of it.

As a result of the varying depths of peat involved, fair comparisons between the two methods are difficult to obtain. Dragline excavation and sidecasting were favoured for two reasons. In the first place, the heavy mat of decayed vegetable matter and tree roots on top of the peat had to be broken up before the fill could be placed for blasting, otherwise the fill would be held in suspension and thereby lose its effectiveness as a surcharge in displacing the underlying strata of peat. The work required in breaking up this mat was a separate and extra operation with the fill-and-blast procedure, while it was an integral part of the dragline excavation method. Secondly, the dragline excavation removed all of the peat, while blasting did not effect complete removal with the size of charges used. The railway embankment was cambered some 5in. over the peat areas and is still above grade.

Runways in a Hurry

The paving at Quonset covers an area equivalent to 100 miles of road, 20ft. wide. Most of the runway pavement installation followed almost immediately on recently placed hydraulic fill, a situation which resulted in an unusual construction operation. The original plan had been to let the fill settle and drain during the winter months and to start paving operations as soon as the frost was out in the spring. Other considerations ruled out any such delay, however, and engineering planning had to give way to construction expediency.

A surface on the frozen fill that could be graded and rolled into a pavement sub-base was the first problem. This was solved by placing a 3in. or 4in. layer of dry material rich in clay binder which was spread by blade graders and compacted with tandem rollers. On days when the sun thawed the surface of the hydraulic fill into mud, gravel was placed ahead of the clay to take up the water. On this latter surface the pavement was then laid. To prevent heaving of the sub-grade due to thawing action, placement of asphalt followed immediately the fine grading and rolling. The only other precaution necessary was to lay the paving hotter than normal, namely, at 350 deg. to 375 deg., and to cover the hauling trucks with tarpaulins to reduce the heat loss in transit from the 20 deg. permitted by the specifications to only 5 deg. The maximum haul from the mixing plant was about 1 mile.

Operations were carried on by three shifts a day in all kinds of weather except rain, and in air temperatures varying from 10 deg. to 40 deg. The arrival of warm weather revealed no settlement of consequence.

The winter work furnished experience in job organisation and construction technique, which proved valuable in laying the rest of the runways. Pavement was laid in strips, 10ft. wide and 800ft. to 900ft. long, the maximum length that would still permit a hot bond with the next adjacent strip. Cold joints had to be painted with hot asphalt before the next strip could be laid.

Variable Pile Penetration

One of the early problems of construction was encountered on the foundation for the general storehouse, a three-storey reinforced concrete structure designed for live loads of 500 lb., 300 lb., and 250 lb. per square foot respectively on the first, second, and third floors. Despite a relatively large number of borings, sub-surface conditions were not as expected and pile penetration varied greatly even in the same 11ft. square footing. Since footings were on 20ft. centres and each contained thirteen piles, the number of pile cut-offs was extremely large and lengths were quite different. Fluted tapered steel shells filled with concrete designed for 30 tons each were used. Despite the taper it was found possible to use the shell cut-offs for lengthening piles that proved too short, or, in combination with new bottom-boot sections, to weld the various length cut-offs into new piles.

Vacuum Concrete

To speed up setting time and form removal, extensive use was made of vacuum mats on the concrete floor slabs in the barracks, landplane hangars, storehouse, operations and administration buildings. Most of this concreting was done in winter weather when heating was required; hence speeding up the time of set by removing excess water resulted in a substantial economy. Procedure in the landplane hangars, for example, was to apply the vacuum mats to the slab surface for about twenty minutes immediately after screeding. The mats were then removed and the slabs covered with burlap, 6in. of hay, and a top covering of burlap. Under this protection the concrete surface temperatures never dropped below 30 deg. even when the air temperature hovered around zero.

Another important use of vacuum concrete was in a casting yard, where slab covers for the miles of utility trenches were made. Here the speed-up possible with the mats permitted 150 of these 3ft. by 4ft. slabs to be poured and removed from the forms in an eight-hour shift.

Reinforced Concrete Carrier Pier

A major structure at the Naval Air Station is a pier extending out into the bay, where deep-draught ships, including aircraft carriers, can berth. Its supports are steel H piles, and the design called for encasing the tops of these piles in concrete down to 3ft. below low water. Pile driving was completed early in February and to avoid delay in starting work on the concrete deck slab the pile encasement had to be done in winter weather. Special protection, therefore, was necessary.

Forms for the encasement consisted of corrugated metal shells. They were supported by two short pieces of railway rail inserted through holes on opposite sides of the shells just above the high-water line and welded to the flanges of the piles. The rails projected about a foot outside the shells and were installed with the wide bottom flange up. They later served as supports for the deck forms. Another function of the rails was to act as shear dowels for the concrete encasement, a service in which they are complementary to steel angles welded to the webs of piles.

Concrete was mixed in a floating plant having heaters in the mixers, and conveyed to the forms in chutes. High early strength cement was used and, as a final precaution, metal drums were lowered over the encasement and fed steam for seventy-two hours. By maintaining a temperature of 70 deg. for this period the concrete attained a strength of 3900 lb. per square inch, as measured by test cylinders broken after forty-eight hours. The period of steam curing was progressively shortened as outside air temperatures rose with the approach of spring.

Erecting 160ft. Span Trusses at the Assembly and Repair Shop

The largest building at Quonset is the assembly and repair shop. This building is notable for its diverse types of framing, ranging from simple beam and girder bays to the 160ft. trusses that span the main assembly aisle. The erection of these trusses, of which there are some two dozen, was accomplished without the use of falsework by assembling them on the ground and lifting them into place with three crawler cranes. Each truss weighs 27 tons, and since their bottom chords are 45ft. above the floor, the erection operations were spectacular, although, as it worked out, relatively simple.

Handling Salamanders Safely

Barracks, administration building and bachelor officers' quarters at Quonset have concrete floors and brick veneer walls. All had to be constructed during winter weather. The usual tarpaulin enclosure and salamander heating was resorted to, but details of the lay-out were somewhat unusual and very effective.

As soon as the two-storey steel frames were erected they were surrounded by scaffolding for the brick masons and enclosed in tarpaulins. At the same time, the permanent roof was put on, giving complete protection from the icy winds. The salamander heaters were then installed, and for safety and convenience were suspended from the second floor beams in wood cradles. The salamanders were so braced they could not tip over. The bottoms of the salamanders were about 3ft. above the first floor, a height that placed them out of the way of the workmen and was at the same time convenient for firing.

Spaced on about 10ft. centres, both ways, the salamanders effectively heated the entire building so that concrete floor slabs could be safely placed. Also, enough heat escaped through wall and door openings to permit masons to lay up the brick walls without having salamanders on the scaffold with them.

Homes for Station Personnel

In a naval establishment of this calibre living quarters have to be provided for the administrative and operating personnel. This part of the construction programme was as unique and interesting in its way as were the more formal engineering problems involved in the development of the operating section of the Station.

Previous to the start of construction operations, summer colonies were thriving at Quonset Point, Willow Point, and Fry's Cove, along the south and west boundaries of Quonset bordering on Narragansett Bay. One of the first projects was to appraise these shore cottages for possible rehabilitation and relocation in the permanent residential development.

A few of the summer cottages were of such flimsy construction they could not readily be used elsewhere and promised to be of little salvage value. Some of these were broken up by simply running a bulldozer through the walls. A total of 275 houses were taken over, some at the season's peak. Occupants were permitted to remain as long as possible and few complaints were registered. A committee of five appointed by the cottagers conferred with the Navy personnel and aided in maintaining generally good feeling. Incidentally, a total of 110 bodies was removed from six cemeteries on the site.

Briefly, there were three distinct uses for these houses: (1) Officers' homes, (2) married enlisted men's quarters, and (3) defence housing for operating personnel. Twenty were selected for officers' homes, twenty were allocated for married enlisted men, and the balance of the usable cottages was set aside for incorporation in the 238-unit housing development for Station personnel.

Each house to be remodelled was given a number. Field measurements were taken; complete floor plans and elevations were drawn; and architectural studies were made to determine the nature and extent of necessary interior and exterior alterations. While the office work was in progress, each cottage was braced and placed on timber skids, dragged by tractors to the predetermined location, and jacked into position on a prepared foundation. Remodelling operations followed and included changes in heating, lighting, and plumbing facilities. To-day these housing groups are places of distinctive beauty on the Station.

Practically all of the relocated houses had to be placed in treeless areas. The land acquired for defence housing immediately adjacent to the Air Station contained many fine trees, and a large number were uprooted, bagged, hauled, and replanted in the vicinity of the personnel buildings. Ordinarily the cost of such a procedure would have been prohibitive, but in this case the heavy equipment brought on the work for other operations was utilised for moving trees at small expense. Extensive green lawns have also been planted, and these, together with the transplanted trees, have already changed the vast waste land into an attractive reservation.

At the peak of construction expenditures ran as high as 1,100,000 dollars per week and averaged between 800,000 dollars and 900,000 dollars per week.

South African Engineering Notes

(By our South African Correspondent)

CAPE TOWN, May 14th, 1942.

S.A. Railways on War Footing

PROBABLE conditions in South Africa in 1942 as a result of Japan's entry into the war are discussed by the Railways and Harbours Board in a report issued on April 18th. The report states that it can be expected that imports will decline, though the loss of traffic should be more than balanced by increased railings of bunker coal as well as coal and base minerals for export. The mining industry should, it is felt, maintain its present high level of activity. Local industries taking advantage of prevailing conditions should continue to expand to meet growing demands for war purposes and to replace manufactured articles previously obtained from overseas. The already heavy trade with the Rhodesias and other neighbouring territories is also expected to increase.

The demand for coal for bunkering and industrial purposes rose steadily during the year (1941–42), and new output records were set up at Transvaal collieries. The monthly figure exceeded the million-ton mark for the first time. A tremendous increase was also recorded in railings of manganese, chrome, and iron ore for export. The demand for trucks could not be met at certain times owing to circumstances beyond the control of the Railway Administration. Numbers of vehicles were sometimes held up for long periods at the ports through the irregular arrival of shipping. The position was often aggravated by the need for giving preference to military traffic. The running of a number of special and relief passenger trains also adversely affected goods services because of the serious drain on engine power and the delays to goods trains. Towards the end of 1941 the Department was compelled to introduce a system of rationing to ensure equitable distribution of trucks among all users of railway transport.

The 1942 maize crop, the report states, is likely to be below normal as a result of the drought, and there is little prospect of an export surplus. Rail transport will consist mainly of conveying maize for home consumption. The export of citrus in 1942 is stated to be uncertain. Indications are that foodstuffs will have preference in the use of refrigerated shipping space. The embargo placed on the export of deciduous fruit is to continue, and the Deciduous Fruit Board will undertake all possible steps for the disposal of the crop, and in addition to sending a large proportion of the fruit to the wineries, canneries, drying yards, and jam factories, will store the export quality peaches, plums and pears in pre-cooling chambers at Table Bay harbour for later distribution to military camps and selected markets throughout the Union. Apples will be stored in the pre-cooling chambers at Port Elizabeth, East London, and Durban and disposed of later in the year on local markets.

The Board praises the war effort of the railways in meeting the increased transport demands of the country turning out a vast amount of munitions in the railway workshops, carrying troops and war material and provisioning merchant and naval shipping. There has been difficulty in obtaining motor spares from overseas for the road transport services, but a number of essential items have been made departmentally. Further expansion in this direction is expected this year.

"Iscor" Share Capital Increased

At the passing of the second reading of a Bill enabling the South African Iron and Steel Corporation to increase its share capital by £6,500,000 and to expand its activities in many ways, the Minister of Commerce and Industries said the works had originally been designed for a capacity of 180,000 tons of raw steel yearly. The capacity to-day was about 350,000 tons, and this would be increased to about 450,000 tons by the addition of the Bessemer plant. When the extensions envisaged in the Bill were complete the plant would have a capacity which would equal two-thirds of South Africa's pre-war steel requirements.

"Iscor" Output of War Products

"Iscor's" great contribution to the Union's war effort and the great range of new steel types manufactured as part of that effort has just been described semi-officially. It is pointed out that the outbreak of war found South Africa dependent on overseas sources for supplies of certain types of steel products, particularly those required for ordnance purposes. With the increased pressure on Britain for war supplies, the growing dearth of shipping, the intensification of submarine warfare, and the virtual closing of the Mediterranean route, the discovery of further sources of supply became essential for South Africa. "Iscor's" resources of personnel and equipment placed it in a position in which it could render immediate help to the Government to-day. As a result, it is manufacturing and supplying, in addition to large quantities of structural products and carbon steel, a rich variety of types new to South Africa of vitally important steels.

Its armour plate is being used for armoured fighting vehicles, tanks, gun shields, and ship repairs. It is making armour-piercing steel for anti-tank purposes, and deep-drawing steels and terneplate. There are also quality high-carbon steels for small arms components, motors and various ordinary requirements, and high-manganese steel for steel helmets. Quality machining steels and forging steel are being made for bomb parts, and the list also contains many steel alloys, including nickel-chrome and chrome-molybdenum-aluminium for aero-engine parts, tank parts, engine parts, and other purposes.

Another series of alloy steels listed are used for aerial bomb casings and other tank parts. Tool steels, non-deforming cold-working die steels, and chisel and punch steel are used for general purposes by the Army and Air Force, Mint, and War Supplies. Finally, many commercial products, such as rails, rope, wire, rods, structural steel, and steel for tubes, sheets and plates, have been supplied by "Iscor" for defence purposes.

Outlook for Base Metals

One of the recurring rumours affecting the price of gold mining shares concerns the possible diversion of labour from the South African gold mines to base metal mines, but it has been pointed out by authorities that the possibilities of base metal production in the Union are, in fact, very limited. The only mineral immediately available in appreciable quantities and capable of bearing the cost of transport to overseas countries is asbestos. But in 1940 the asbestos industry employed only 4753 workers, who produced 23,170 tons of asbestos, valued at £497,061, or about £22 a ton. Platinum, it is true, is being produced in the Union and large quantities could be supplied; but unfortunately, the demand is very limited so far and the number of men employed is therefore negligible, though it is possible that in the great war machine it may be found a new place and so a much larger demand be created.

In the case of chromium and manganese the Union is able to supply much larger quantities than have so far been required, and the prices ruling do not encourage any expansion of the output capacity. In 1940 the mines here realised a little more than £2 per ton from an output of 117,297 tons of chrome ore and 313,220 tons of manganese ore. The production is always doubtful, depending on transport costs and facilities.

The Government's new regulations and parliamentary measures to assist prospectors, particularly the provisions compelling landowners to allow prospecting on their land and obliging them to allow development of discoveries made, will certainly give a great impetus to search. In regard to natural oil, the Minister of Mines has informed the House that his technical advisers have informed him that there are distinct possibilities of obtaining natural oil in the Union. The possibilities are so great that it is in the interests of the State to investigate them.

Among the minerals and metals which the Union contains and to which prospecting will no doubt be specially directed are cadmium, fluorspar, Iceland spar, lithium, tungsten, cobalt, vanadium, beryl, magnesite, and, of course, natural gas, which at present has only been exploited on the Umzinkulwana Reserve, Alfred County, Natal. Endeavours will also no doubt be made to discover additional deposits of copper, nickel, lead, and tin, of which the quantities it is now possible to mine are only comparatively small tonnages.

Fuel from Sugar Cane

Dr. John Fisher, Principal of the Cedara School of Agriculture, when he opened the sixteenth Annual Congress of the South African Technologists' Association in Durban, on April 21st, said that in unison with other industries the sugar industry at this time was faced with very grave difficulties. The difficulty of surplus cane no longer existed, for the "green light" had been for an all-out production during the war period. Surplus areas and marginal lands had temporarily faded into the background. But with the terrific upset in the supply of petrol a new avenue was opening, which would consume the surplus in the form of alcohol for power purposes. That was an urgent problem that should be constantly investigated by the Sugar Committees, so that if and when conditions demanded it, action could be ready planned. At a later stage of the Congress a review of fuel alcohol production was given by Mr. G. C. Dymond, who pointed out that the cost of landed petrol is about 4d. a gallon, without the duty. The cost of alcohol from molasses is about 7d. and from sugar cane and molasses about 1s. upwards, according to quantity and the price for cane. While petrol was available in plenty, and at a low price, there appeared little likelihood of any serious development of alcohol production for the simple reason that the Government collected about £5,870,000 in petrol taxes. But now the time seems to have arrived when it can be demonstrated that the possibilities of fuel alcohol development from sugar cane surpluses can be considered on their merits, seeing that such a fuel would be used to replace unprocurable petrol.

Model of Cape Town Dry Dock

A fine model of Cape Town's graving dock, which is expected to be completed within the next two or three years, at a total cost of £2,500,000, has been built at the Department of the Table Bay Harbour Engineer. Resting in the dock is a model of the Union-Castle's finest liner, "Cape Town Castle." Graving dock and ship are true to scale on the assumption that the dry dock will be 1250ft. long and 150ft. wide. The Government has not decided on the exact size of the dock, although the choice of two sizes—1000ft. or 1250ft.—has been under consideration for some time. The model, however, shows the relative size of one of the largest Cape liners inside a dry dock of the larger dimensions. Actually the dock consists of two sections, an outer dock of 720ft. and an inner dock of 500ft. Thus there are two caissons, one at the entrance and one separating the outer from the inner dock. The length of the outer dock can be increased from 720ft. to 775ft. by placing the outer caisson in an emergency position. The model shows steel caissons that move on rollers. When it is desired to open the docks, the caissons are moved to underground chambers alongside the dry dock, where they are completely concealed. Along the floor of the dock are three rows of keel blocks, upon which the ships rest during repair. The model also shows buildings to accommodate the pumping plant and caisson hauling machinery. Along each side of the dry dock are a crane track and two sets of railway lines. The model has an overall length of 8ft. Preliminary reclamation work necessary to prepare the actual site of the graving dock at the Woodstock end of the new Table Bay harbour is now proceeding at full speed. The greater part of the dyke outlining the whole graving dock area is already above water.

The Engineer

JULY 10, 1942

VOL. CLXXIV No. 4513

Contents

THE ENGINEER, July 10th, 1942 PAGE

A SEVEN-DAY JOURNAL ... 21

LEADING ARTICLES—
ENGINEERS IN THE ARMY ... 32
SCIENCE AND LOGIC ... 32

SPECIAL ARTICLES—
KINGSLEY DAM. No. I. (Illus.) ... 35
NON-METALLIC CHEMICAL PLANT. No. II. (Illus.) 25
RAILWAY SIGNALLING FOR WARTIME TRAFFIC. No. II. (Illus.) ... 22
AGRICULTURAL MACHINERY DEVELOPMENT BOARD... 40
CONSTRUCTION AT QUONSET NAVAL AIR STATION ... 29
ENGINEERING APPROACH ... 27
HIGH-SPEED TENSILE TESTS ... 28
INCREASING PRODUCTION ... 34
PRECISION PIPE BENDING ... 40
PRODUCTION OF UNIFORM STEEL FOR A LIGHT CASTINGS FOUNDRY ... 38

LETTERS TO THE EDITOR—
FRENCH LOCOMOTIVE PERFORMANCE ... 33
ENGINEERS IN THE ARMY ... 34

LITERATURE—
BOOKS RECEIVED ... 34

OBITUARY—
CHARLES DE GRAVE SELLS ... 33
J. HARCOURT WILLIAMS ... 33

NEWS AND NOTES—
FORTHCOMING ENGAGEMENTS ... 42
MARKETS, NOTES AND NEWS ... 41
NOTES AND MEMORANDA ... 42
SIXTY YEARS AGO ... 34
SOUTH AFRICAN ENGINEERING NOTES ... 31

NOTICES TO READERS

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper or described in its editorial columns should not be taken as an indication that they are necessarily available for export.

With a view to the conservation of paper, readers are advised, in the interests of all concerned, to place a regular order for THE ENGINEER with their newsagent or direct with the Publisher.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** For Subscription rates, see page 2 of Advertisements.*

**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Postal Address: "The Engineer," 28, Essex Street, Strand, London, W.C.2.

Telegraphic Address: "Engineer Newspaper, Estrand, London." Telephone: CENtral 6565 (10 lines).

ENGINEERS IN THE ARMY

WE were happy to be able to record in our Seven-Day Journal last week that, in consequence of a leading article in our issue of June 12th, Mr. Woodburn had asked the Secretary of State for War in the House of Commons if he would consider "such a readjustment as to permit of such promotion for engineer officers as will bring their advice and ability on to levels commensurate with the importance of mechanical warfare"; whilst Mr. Walter Higgs reminded the Secretary that officers in the Army "who remain constant to engineering have no chance of rising to a higher rank than Major-General," and asked him to investigate the possibilities of removing that restriction. In his reply, Sir James Grigg promised that the desirability of providing suitable promotion prospects for officers with mechanical engineering knowledge would not be lost sight of. This reply encourages the hope that technical officers will, before long, receive the consideration that the importance of their work merits. If this hope is realised, we shall rejoice that our article has led to an improvement in the lot of engineers, but still more, that a step which directly recognises the influence of engineering in warfare has been taken.

Our leading article of June 12th brought us many private letters from engineers. With barely an exception, they expressed approval of the plea we had made. Few of the writers, and we suspect few members of the House of Commons and the general public, were aware that mechanical engineers could never rise above the rank of Major-General while in technical appointments, but only if they went over to the General Staff or purely military side. It has been argued on philological grounds that since "General" means an officer who takes command of troops in the field, and since Lieutenant-General is a Lieutenant to a General, the lower rank as well as the higher cannot rightly be awarded to an officer whose duties are not necessarily in the field. Whilst we do not challenge that argument, we may point out that it deprives engineering officers of the encouragement and recognition that the importance of their work merits. It has another effect, too, which should not be overlooked; indeed, it is one that must be regarded as of great importance. The engineer officer is called upon to decide quite early in his career whether he will follow the technical or the combatant side. If the latter, which holds out greater possibilities to the ambitious man, he seeks admission to the Staff College. Once there, engineering becomes to him only of secondary importance. His concern is with strategy and tactics and his interest in the technical aspects of machines of war is small or non-existent. Questions of an engineering nature are foreign to him. Whilst he may be expert in the handling of machines, he has lost touch with the technological problems of their design, construction, and maintenance. We do not indicate these facts in any critical spirit. They represent a well-recognised and desirable division of duties. Just as no one expects the commander of a warship to be primarily a technologist, so no one expects the generals in command of armies to be expert engineers. We find it necessary to make this point quite clear, because one or two of our correspondents seem to think that we were seeking for equal ranks for combatant and technical officers on the field of battle. That was not our purpose. The place for the technicians in the higher ranks is at home where their experience of military operations combined with their knowledge of engineering enables them to give sound advice both on design and production. Our plea was, and is, that the officers, not many in number, who fill the highest technical posts should be given the rank of Lieutenant-General. We trust this explanation will remove any misconception that our article may have caused. In this connection we would ask our readers to study an admirable letter by "Major (Retired)," which is printed this week in our correspondence columns.

It will be seen that what we are asking for involves no great or radical change. Only a handful of officers would attain the higher rank, but the knowledge that that rank, with all that it implies in position and emoluments, was open to them, would, on the one hand, induce more men of the highest capabilities to devote themselves to the technology of the Army, and, on the other hand, would be an official recognition that the mechanisation of our military forces is worthy of the highest regard. Is it unreasonable to ask that what has been done in the Navy in this respect should be done in the Army, or that the highest rank thrown open to the Army's medical representatives should also be open to its far more numerous, and not less vital, engineers?

Science and Logic

FORMAL logic is the abomination of desolation to all but a few. Like formal economics, its purpose seems to be to obscure the obvious. Often it conceals the commonplace behind difficult words and strange symbols. Hence it is esoteric and only the initiated can understand it. Moreover, we all believe we are logical—save when it suits us to be otherwise. Then we damn logic as a form of red tape, which seeks to crib, cabin, and confine our imaginations and aspirations. Just as modernistic artists defy perspective, and modern versifiers contemn rhyme and rhythm, so many of the younger thinkers of to-day rebel against syllogisms which contain conclusions unwelcome to them. "Methodical thought processes," writes Lieut.-Commander R. E. W. Harrison, of the United States Naval Reserve, in a paper reprinted on page 27, "are at present denied to many people in all walks of life, the result being seen in reliance on emotionalism, hunches, incomplete analysis, theatricalism, and the use of just plain ordinary sloppily incomplete data."

For "methodical thought processes" read logic, and it will be seen that Lieut.-Commander Harrison and we are saying the same thing in different words. We are both agreed that there is a great deal of sloppy, or, preferably, cotton-woolly thinking, but whereas it is sheerly obnoxious to him, we would be more tolerant to it, for we see in it the endeavour of imagination to break away from traditional forms of thought and escape into new and pleasanter fields. Lieut.-Commander Harrison holds that "all human problems yield to analytical treatment." That might be true were our data complete and were our analysis of them unchallengeable. Everyone knows that even where we have copious data conclusions differ because different people combine the data in different ways. For example, it was found that in a certain year in Germany the sale of pianos reached a peak. In the same year the number of murders in Germany also reached a peak. The last term of the syllogism is obvious. That form of error is far more common than might be supposed and all the skill and artifices of logic or "methodical thought processes" cannot prevent it. It is because the possibility exists that the data have been wrongly combined in the past that we listen with toleration to those heterodox thinkers who are testing other combinations. We

have not in mind the "mentally lazy and emotional, rather than mentally alert and factually analytical" people who propound new social and economical schemes without either the ability or the will to devote close thought to them, but only those who are earnestly seeking for new combinations of old data which may lead to the foundation of a happier society.

Lieut.-Commander Harrison writes that his "article is a plea for the teaching of methods of analysis to all students as a part of their formal education." It is clear that he does not mean a revival of the study of formal logic, which was at one time an important element of university education and led to all sorts of extravagances of thought, but rather the sorting out of scientifically acquired data. With regard to that it may, we suggest, be claimed that scientific education is based on that method. Science implies logical thinking. It moves from one stepping stone to the next, carefully testing each before it puts its weight upon it. Even when it leaps wide gulfs with an hypothesis it goes back upon its tracks and if it cannot prove each step, gives up its dream. But few people learn the scientific method and many think sloppily. Whether it is possible to educate everyone to apply "quantitative analysis to the problems of everyday life," Lieut.-Commander Harrison's plea for the attempt is so ingeniously and wittily put that it is well worth reading.

Obituary

CHARLES DE GRAVE SELLS

MARINE engineers and naval architects of the older generation will learn with deep regret of the death, in London, on Monday, June 29th, of Charles de Grave Sells. Sells was a Maudslay man and went to Italy early in his career, to supervise the construction of marine engines in the Ansaldo works. He married and settled down near Genoa and for close upon half a century represented British interests in Italy and did much to promote commerce and the interchange of ideas between British and Italian engineers. He was greatly respected as a marine engineer and naval architect, and his death will be mourned by many old friends.

Charles de Grave Sells was born in 1856 and received his early education at King's College School and his technical training at King's College, London. He was apprenticed with Maudslay, Sons and Field, and served the usual long pupilage, working in the shops and shipyard and the drawing-office. Following his yard experience, he went to sea and took his First Class Board of Trade ticket in 1908. He then began his lifelong interest in naval ships by serving in an Argentine warship for a year as chief engineer. On his return to England he rejoined Maudslays and became assistant outside manager in the firm. He then went to Italy for Maudslays and was entrusted with the supervision of the construction of marine engines in the Ansaldo works at Sampierdarena, which had been arranged by the Italian Minister of Marine. That position he held for some eight years and was responsible, not only for the building of engines and auxiliary machinery, but their installation aboard ship, and the running of trials. In later years he represented several British firms at a time when British engines and boilers and ship auxiliaries were of great interest to Italian shipbuilding and marine engineering firms. Sells took a leading part in the arrangement and the judging of engineering exhibitions in Milan in 1906 and in Turin in 1911, and he was a member of the International Jury. He was also Councillor for the British Chamber of Commerce for Italy. During the last war he assisted in *liaison* work between the two countries and was from 1916 to 1920 a member of the High-speed Steel Committee. Apart from his own work, Sells found time for writing on various technical and other subjects relating to British and Italian engineering, and he formed a friendship with the late Fred T. Jane and wrote the engineering articles in "Jane's Fighting Ships" from 1902 until 1914. From time to time he was a valued contributor to the columns of THE ENGINEER. He was a member of the Institution of Civil Engineers and the Institution of Naval Architects, and when in 1929 the latter held its summer meetings in Italy, Sells took a prominent part in making the arrangements, and in the meetings and visits at Rome, Naples, Genoa and Venice. For many years he lived at Cornigliano Ligure and later at Quinto, but subsequently returned to this country.

J. HARCOURT WILLIAMS

IT is with much regret that we have to announce the death, on the 7th inst., of Mr. J. Harcourt Williams, Deputy Chief Engineer to the Manchester Corporation electricity undertaking. Mr. Williams was in his sixty-sixth year and served his apprenticeship with the British Thomson-Houston Company, Ltd. He was associated with that firm for thirty years, during the last ten of which he was in charge of its Manchester and District Branch. He was a member of the Institution of Civil Engineers and the Institution of Electrical Engineers and was Chairman of the North-Western Branches of both. He was also Past-Chairman of the Engineers' Club, Manchester, an institution in which he took a particular interest. When Chairman of the Manchester and District Association of the Institution of Civil Engineers, in 1934–35, Mr. Williams gave a most interesting and comprehensive address on "Electricity in Relation to Civil Engineering." In that address he presented the Institution with some very valuable information on the use of electricity, both during the construction of, and as the source of power for, civil engineering works. Electric traction, electric haulage on canals, and electric welding were all dealt with in the address.

Mr. Williams, during his connection with the B.T.H. Company, was responsible for the supervision of the constructional works on many large contracts. He was appointed Deputy Chief Engineer to the Manchester electricity undertaking in 1930. During the present war he acted as Honorary Secretary of the Electrical Coal Advisory Committee for North-West England. Until a few weeks ago he was apparently in the enjoyment of perfect health and physical fitness. He had, however, to undergo a surgical operation, from which he made a rapid recovery, enabling him to return to his duties; but subsequently he had a relapse, from which he did not recover.

There was probably no member of the engineering profession in the north-western part of England who was more highly esteemed, and his kindly and unassuming presence will be greatly missed by all who had the good fortune to know him intimately. He was a widower and leaves two sons, one of whom is in the Air Force.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

FRENCH LOCOMOTIVE PERFORMANCE

SIR,—The writer, having had the privilege of being present during several tests with French compounds embodying Monsieur Chapelon's improvements, has been interested in the letters on the above subject. The discussion of locomotive performance during a worldwar is not likely to serve any useful purpose, but it is a harmless form of relaxation, and some of the ideas expressed might be stored away for future consideration.

These modified French compounds are of equivalent weight and heating surface to modern locomotives in this country, but the power they are capable of giving out in economical cut-off positions is almost unbelievable.

The writer was present during a 300-mile run with a 650-ton train over a very difficult line with several long gradients of 1 in 100. On one of these a speed of 47½ m.p.h. was maintained; the draw-bar pull was 9½ tons, the draw-bar horsepower 2690, or with allowance for the gradient 3180, equivalent to over 1¼ H.P. at the draw-bar for each square foot of evaporative heating surface. The cut-off was 50 per cent. in both high-pressure and low-pressure cylinders, equivalent to about 25 per cent. with single expansion.

The experimental work on these locomotives was done by using other locomotives, fitted with counter pressure brakes, behind the dynamometer car, and these regulated the load and speed as required. This enabled accurate performance curves to be obtained in any cut-off at any required speed, and also accurate figures for coal and water consumption. During one of these tests, at which the writer was present, the speed was kept practically constant at 68 m.p.h. for a distance of about 70 miles, the draw-bar pull was very steady, averaging 5·9 tons, equivalent to 2390 H.P.; the steam temperature averaged 750 deg. Fah.

The cut-off was 35 per cent. high-pressure and 45 per cent. low-pressure, equivalent to about 17 per cent. with single expansion. A pull of this magnitude at this speed and cut-off is something to think about. It is 23 per cent. of the rated tractive effort at slow speed when working simple and 29 per cent. when working compound. The pull at similar speed and cut-off with a single-expansion locomotive is less than 15 per cent. of the rated tractive effort.

The outstanding performances that these locomotives are capable of is usually attributed to the large steam pipes, and the free exhaust given by the twin blast pipes. These are useful contributions, but the main reasons are the high superheat which limits condensation in the low-pressure cylinders, and, most important of all, the much less restriction through the cylinder ports than with a single-expansion locomotive, the longer cut-off with the compound for the same ratio of expansion resulting in the improvement of three conditions which influence admission; the steam port remains open about 50 per cent. longer time, it opens about twice as wide, and has a better hydraulic mean depth.

The statement made by Mr. E. B. Parker in your issue of May 22nd that the last indicator diagram on page 431 shows that the single-expansion locomotive with the existing type of valve gear can extract as much energy from the steam as a compound is a popular belief, but unfortunately incorrect. Actually, there is very little useful expansion, the pressure drop is mainly due to wiredrawing and early release, and the compression is harmful. The compound diagrams on page 496 in your issue of June 12th show the small amount of wiredrawing due to

the much better port opening at a long cut-off. It is appreciated that these were obtained with poppet valves, but a piston valve in this cut-off on the high-pressure cylinder would have approximately a ¾in. opening, so the wire-drawing should not be excessive at high speeds.

There is no insurmountable reason why a single-expansion locomotive cannot be made as efficient as a compound, but it would give the writer much satisfaction if he could agree with your correspondent of June 12th that it can be accomplished with valve gears at present in use. In order to take full advantage of high-pressure superheated steam, a cut-off of 15 per cent. or less is necessary, but in this position at high speeds the pull is too small to be much use, owing to present valve gear limitations.

The writer was entrusted with the development of counter-pressure brake testing in this country, and after obtaining reliable performance curves, has acquired a certain amount of humility and the ability to do a bit of unlearning.

If, after the war, locomotive engineers wish to produce a single-expansion locomotive that will give a pull at high speeds and early cut-off as good in proportion as these compounds, they must concentrate their ingenuity on developing a type of valve and gear giving a wide port opening with good hydraulic mean depth, straight steam path, and small clearance space.

The writer has just seen the leading article on "High Powered Locomotives," in your issue of June 26th, and is very gratified to note that the importance of enlarged steam passages is now receiving attention, but it is hoped that the importance of hydraulic mean depth will also be realised. The 14in. piston valve referred to may have a large calculated area, but at 15 per cent. cut-off the opening is only a narrow slit, which remains open about a thirtieth of a second at high speeds and the big valve introduces the disadvantage of large clearance volume.

The indicated horsepowers shown are impressive. They would be more instructive if the cut-off were stated and the draw-bar horsepower. The figure of 76 lb. of engine weight per indicated horsepower is an improvement on the earlier figures given, but it falls short of that possible with the French compounds.

The 3180 draw-bar H.P. previously referred to is equivalent to 73½ lb. of engine weight per draw-bar horsepower, or somewhere about 65 lb. per I.H.P.

T. ROBSON.

Darlington, July 3rd.

ENGINEERS IN THE ARMY

SIR,—The article appearing under the above title in your issue of June 12th brings much-wanted publicity to anomalies which the recently formed Corps of Electrical and Mechanical Engineers should go far to remove.

This presumed unification of technical control is a too-long delayed recognition of convincing evidence born of experience gained in the last war that mechanisation with its advantages of quicker decisions and greater economy in human lives would rapidly supersede battle strategy and tactics based on pre-1914 military text-books.

If full consideration is given to the absolute indispensability of the engineers in modern war establishments, the command of such a composite arm should undoubtedly entitle the holder, as well as other engineers adopting the Service as a career, to qualify for the rank of Lieutenant-General and the higher ranks in the Orders of Chivalry.

The rank of such an officer would need to be sufficiently high to enable him, with the aid of an engineering staff, to become the sole arbiter in questions turning upon the suitability, and performance in action, of materials, design, construction, and the improvisation which only an engineer understands, necessary to counter any temporary technical advantage enjoyed by the enemy.

Correspondingly higher subordinate ranks should also be open to commands in the field of operation, hitherto limited to the rank of Colonel, and held by non-technical officers in positions long calling for engineers experienced in applied science, mechanics, and specialised knowledge appropriate to total mechanisation.

It would seem that corps and regimental precedence has held sway so long that in the comparatively short time allowed in which to apply lessons painfully learnt, and bring the mechanisation of our land forces up to date, the true significance of the engineers' contribution to the "robot" efficiency of modern war machinery has been inadequately rewarded.

July 3rd. MAJOR (Retired).

Sixty Years Ago

THE BOMBARDMENT OF ALEXANDRIA

THE bombardment of the forts at Alexandria on July 11th, 1882, by the ships of the Channel Fleet, under the command of Sir Beauchamp Seymour, was the first occasion on which ironclads had engaged shore guns. As we mentioned last week, little doubt prevailed before the event that the ships would easily overcome the forts. And so it proved. The gunners of Arabi Pasha's rebel forces fought much more valiantly than had been anticipated, and their guns and ammunition supplies proved to be better than expected. Some of the guns, it is true, were smooth bores, but others were 12-ton and 18-ton rifled Armstrong weapons, identical with the majority of the guns on our ships. The action opened at 7.4 a.m. and ceased at about 5.30 p.m. Firing was resumed for a short time on the following morning, but was soon stopped by a flag of truce. For the results achieved there was a prodigious expenditure of ammunition. Our ships fired 1741 heavy projectiles, 1457 light projectiles, and over 33,000 machine gun and rifle bullets. The Egyptians opposed us with about 156 guns, disposed in forts occupying a front of some 10 sea miles. Our firing dismantled or disabled about twenty-seven of the enemy's guns and put five temporarily out of action. Some of this damage was done, not during the heat of the action, but by the deliberate fire of our ships after the enemy had been silenced. The British vessels received a total of seventy-five hits, none of serious consequence, in spite of the fact that for at least part of the time some of them fought at anchor about 1000 yards off-shore. Our casualties amounted to six men killed and twenty-seven wounded. The action undoubtedly encouraged the view that armoured war vessels could be relied upon to deal successfully with land guns—an opinion which prevailed in many quarters even up to 1914. There can, however, be no doubt that had the Egyptian gunners' training been equal to their valour, the lesson learned would have been a different one. . . . To-day Alexandria can once again hear the sound of guns in an infinitely sterner struggle for its possession. Compared with the fighting now raging in the Egyptian desert, the whole of the campaign of 1882 was little more than a skirmish. For the land operations which followed the bombardment of Alexandria, Sir Garnet Wolseley had under him not more than about 32,000 troops. At the battles of Kassassin on August 28th and September 3rd we lost 17 men killed. At the final battle at Tel-el-Kebir on September 13th our losses amounted to 58 killed, 379 wounded, and 22 missing.

RELAXED ELECTRICAL REGULATIONS.—Recommended war emergency relaxations of the regulations for the electrical equipment of buildings have just been published by the Institution of Electrical Engineers. Copies are obtainable from the Institution, free of charge, except where a number of copies is required.

Increasing Production

THE following, which is described as "An open and friendly letter to Mr. Jack Tanner, President, Amalgamated Engineers' Union," has been sent to us by Mr. J. McLean, managing director of Parker Foundry (1929), Ltd., Derby, for publication :—

Dear Mr. Tanner,—In your recent address to the delegates at Blackpool you were responsible for statements which, I feel sure, need explanation in more detail.

(1) With regard to contracts placed by the various Government Departments, if you, Mr. Tanner, owned a shipbuilding yard or an engineering works, would you be prepared to fill your order book for six or twelve months at the fixed current prices, and take the risk of a demand from trades unions for an advance of 34s. 6d. per week ? Surely it is not unreasonable for a contractor to ask for a safeguard against such a possibility and to avoid heavy loss. In a contract of any description there are generally reasonable safeguards.

(2) Is this demand from the delegates for an advance of 34s. 6d. per week (and which you properly described "as a plateful") not a definite form of profiteering ? From your own remarks it is clear that you considered it "foolish."

(3) You also referred in your address to persons who were impeding production in their own financial interests. The general public will read into this that you meant certain employers, but you were not able to give any facts or names to justify your allegations. We know that you, Mr. Tanner, and all other trades union leaders, have free access to Mr. Ernest Bevin, Minister of Labour, who works in close contact with the Minister of Production. If you have reliable information about any firm or firms or managements, deliberately hindering war output, surely it would be simpler, better, and much more effective if you passed the details to Mr. Bevin for quick action.

(4) I am convinced that various federations of employers would gladly confer with you and co-operate with you in putting a stop to any hindrance to war output, whether the fault lies with management or workers, but, Mr. Tanner, vague allegations from either side would have to be ruled out and only facts would count.

(5) It is worse than regrettable that public utterances of a vague (but harmful) character should be made by employers, trades union leaders, or other responsible persons, particularly at this time, when the nation is fighting for its very existence.

Surely we should work together to the fullest extent, with the object of winning the war. If we fail in our endeavour, it means that we will all sink together.

BOOKS RECEIVED

The Colliery Year Book and Coal Trades Directory-1942. London : The Louis Cassier Company, Ltd., 22, Henrietta Street, W.C.2. Price one guinea net.

Strength of Materials, Vols. I and II. Second edition. By S. Timoshenko. London : Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 50s. net, 2 vols.

The Calculation of Unsymmetrical Short Circuits. By H. Rissik. London : Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 7s. 6d. net.

Definitions and Formulæ for Students. By E. R. Taylor. Second edition. London : Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 6d. net.

Practical Mathematics. By L. Toft and A. D. D. McKay. Second edition. London : Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 15s. net.

A Pocket Book for Mechanical Engineers. By D. A. Low. Revised by B. B. Low. London : Longmans, Green and Co., Ltd., 43, Albert Drive, S.W.19. Price 15s. net.

Fuel Research Survey Paper, No. 53 : "Nottinghamshire and Derbyshire Area—The Top Hard Seam." London : His Majesty's Stationery Office, Kingsway, W.C.2. Price 6s. 6d. net.

The Kingsley Dam

No. I

THE Central Nebraska Public Power and Irrigation District is now putting the finishing touches on the Kingsley dam, part of a project that will ultimately involve total expenditures approximating 38 million dollars.

The primary purpose of the entire undertaking is to bring about the regeneration of an established agricultural life of four Nebraskan counties situated in the south central section of the State and contiguous to the Platte River, which traces its course across the entire State from west to east.

Reclamation developments in the United States have generally been for the purpose of turning arid sections into productive farmlands through the medium of irrigation. In the case of the counties of Gosper, Phelps, Kearney, and Adams in Nebraska, farmers were attracted to the section about seven decades ago because the wild grasses then growing in abundance indicated a fertile soil and one that at the start would favour cattle raising, the region being part of a vast expanse known as the Great Plains. Nature had laid a deep stratum of loess soil, and over untold centuries the recurrent rotting of the grasses had produced a heavy blanket of humus that enriched the soil, readily absorbed rainfall and carried it into the ground for storage, and also protected the land from the erosive actions of wind and rain. The climate is a healthful one, but rainfall varies more or less widely from year to year and from season to season. Under former conditions, the rainfall was ample for the flourishing growth of stands of native grasses, and the undisturbed soil caught the rain and transmitted it deep into the ground for storage. These immemorial conditions were accepted without analysis by the earlier settlers, and the influx of latter-day farmers began only about 1880, intensive use of the soil increasing thereafter and making year by year heavier drains upon its fertility and the indispensable moisture due to rainfall and to age-long moisture stored in the ground.

The climate of Central Nebraska may be described as a semi-arid one, and despite earlier records of an abundance of grass for cattle and the raising of varied crops in profitable volumes, as cultivation widened and intensive farming was practised, the yields and the profits decreased and became uncertain, rainfall becoming the lone substitute for the ground water formerly available and ample. The farmlands in the four counties served by the Central Nebraska Public Power and Irrigation District represented an investment of more than 92 million dollars, when an appeal was made to the State and the Government to suggest ways and means to arrest further decadence of the farming industry and to bring about its revival on a sound basis. In 1924 an expert of the U.S. Department of Agriculture, who had collaborated with experts of the University of Nebraska College of Agriculture, reached this conclusion: "Without supplemental water, the writer believes that within a generation the region under consideration will be obliged in a great measure to revert, first, to dependence upon summer fallowing, thus producing on a given tract of land only one crop in two years, and later back again to grazing for the reason that the production of crops will no longer be possible." In short, nothing but irrigation would save agriculture in the four counties mentioned, and to make that possible it would be necessary to conserve from the flow of the Platte River as much as practicable of the 2 million acre-feet of water that left the State annually unused to join the Missouri River on the long journey to the Gulf of Mexico.

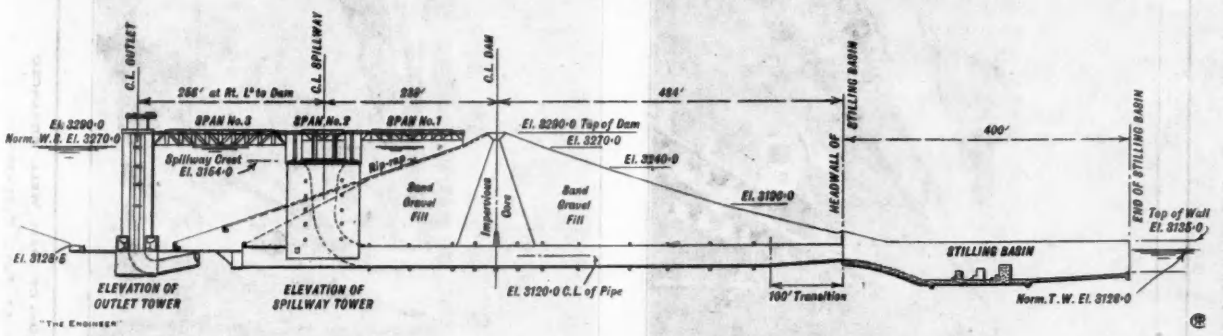
The problem presented the people of the four interested counties was a two-fold one. First, to obtain the desired water from the river and to make the water provide both power and irrigation, so that the ultimate cost to the consumers would be a moderate one. The plan developed by the Central Nebraska Public Power and Irrigation District covers these two requirements, and on August 29th, 1935, the project received Government support through a grant and loan approved by the Public Works Administration; 45 per cent. of the cost of the undertaking being an outright grant by the Federal Government, while the remaining 55 per cent. will be paid back over a long period of years at a reasonable rate of interest. Actual work on the project was started in the first half of 1936.

The Kingsley dam is on the North Platte River, which meets the South Platte River to form the Platte River at a point about 95 miles north and west from the centre of the four counties of the power and irrigation district, and the dam site is 50 miles farther away as the crow flies. The dam was situated there because the conformation of the river valley and other considerations made that site especially suitable both for the building of the dam and for creating a reservoir capable of storing 2 million acre-feet of water. The impounding area is known as McConaughy Lake, which has a superficial area of 32,000 acres, a maximum width of 4 miles, and backs up the river for a distance of about 23 miles. This basin is for storage purposes only, and water released from it between flood stages will stabilise the flow so as to meet the requirements of "senior appropriators" downstream, and also to deliver stored water that may be sold to other appropriators and to maintain the flow into the canal system of the irrigation system.

After its discharge from McConaughy Lake the water, which passes over the diversion dam of another project, flows downstream a distance of 50 miles to the point where the North Platte River and the South Platte River meet to form the Platte River. A mile below this confluence the Central Nebraska Public Power and Irrigation District has built its Upper Diversion dam, at a cost of 277,000 dollars, which turns water from the Platte River into the supply canal of the district. The supply canal has a length of 76 miles, and it was dug along and through the hills to the south of the Platte River. The Platte River has a natural fall of about 6ft. to the mile, but the supply canal has a fall of but 4in. to the mile, and this difference between the slope of the river and the slope of the canal makes it possible at three points to drop the canal water from considerable heights to furnish energy for three hydro-electric plants, the head of two of the plants being 116ft. and of the third plant 146ft.

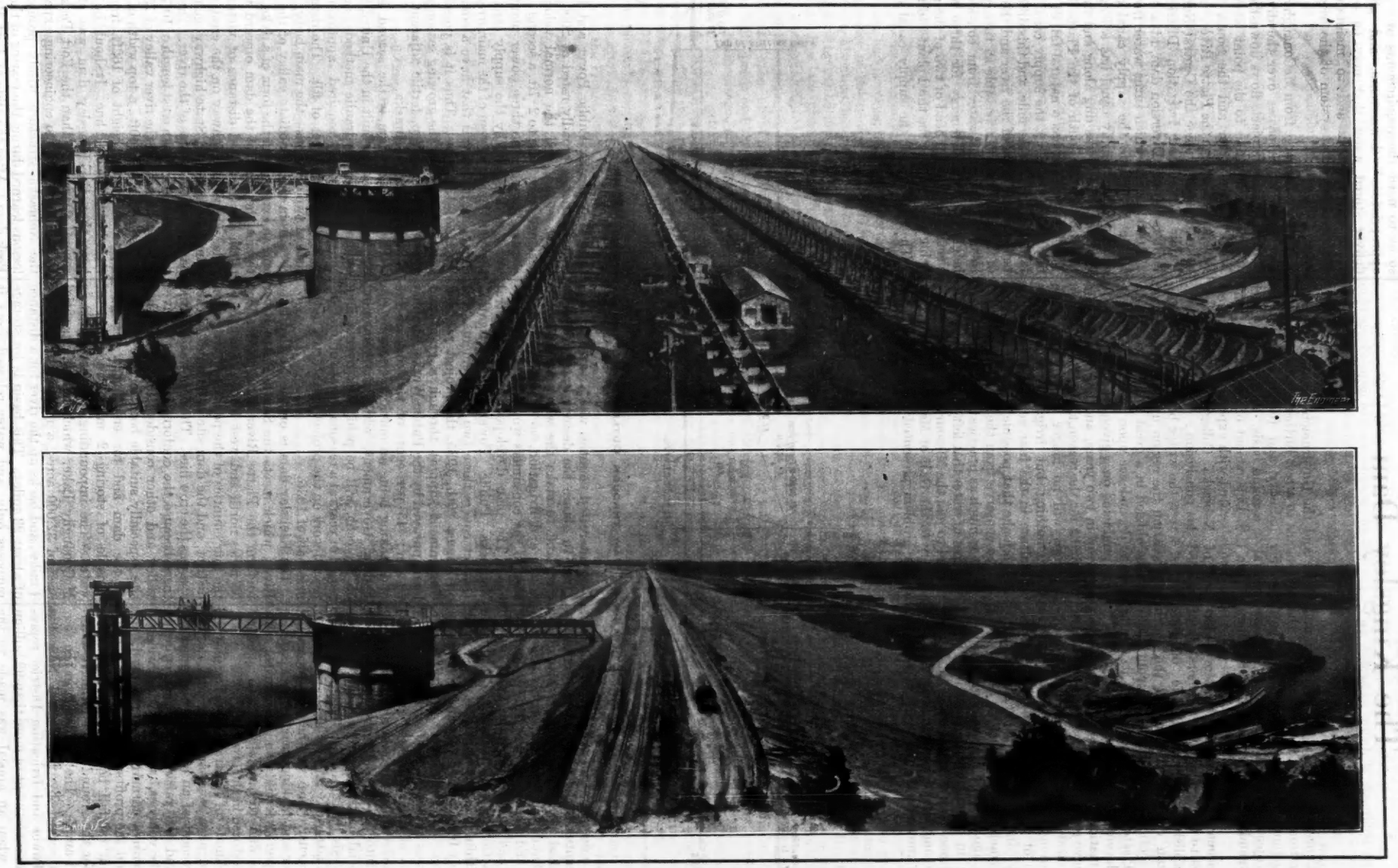
The capacity of the supply canal of the Central Nebraska Public Power and Irrigation District is broadly rated at 2000 cubic feet a second, and the normal velocity is designed to be close to 2·7ft. a second. After passing through the three power plants the water is delivered by the supply canal into the distributing system of the main irrigation canal and its laterals that have a combined length of 433 miles. Thus it is possible to assure throughout the growing season ample moisture to the deep, fertile adjacent lands of South Central Nebraska.

The Kingsley dam is the second largest earth-fill structure built in the United States by present-day hydraulic methods, and its construction has required approximately 27 million cubic feet of fill. The dam consists of two divisions—the main body, which rises from the immediate valley of the river, and an extension in the form of a dyke which carries the crest of the dam onward to the north for an added distance of virtually a mile, where the highway on the crest of the dam joins a resited State highway, generally paralleling the course of the river. The main body of the dam has a crest length of 10,700ft., a bottom length in the river valley of 7500ft., a base width of 1140ft., a top width of 30ft., and a maximum height of 162ft. from the river bed to the crest line. It should be noted here that the Kingsley dam was started several years later than the Fort Peck dam in Montana, and the engineering experts of the Nebraska structure wisely profited by lessons learned during the rearing of the Fort Peck dam. After the slide at Fort Peck on



SECTION OF DAM THROUGH OUTLET AND SPILLWAY TOWERS

CONSTRUCTION OF THE KINGSLEY DAM, NEBRASKA, U.S.A.



CONSTRUCTION OF DAM WELL ADVANCED
DAM AT FULL ELEVATION

the upstream slope on September 22nd, 1938, the plans of the Kingsley dam were modified by considerably flattening the upstream slope between elevations 3160 and 3180, the added material being counted upon to increase considerably the stability of the toe section of that slope.

CONTROL FEATURES

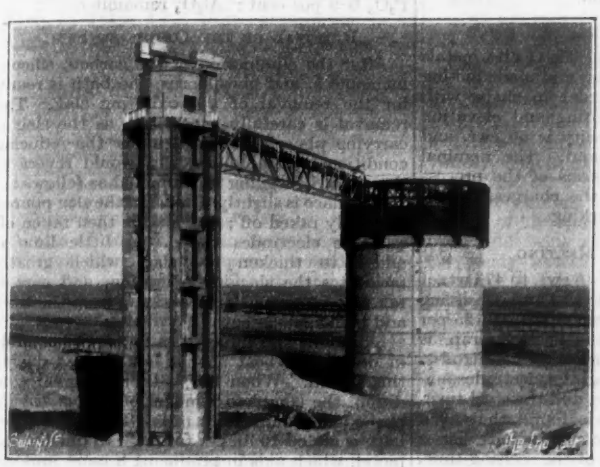
The two control features are both situated adjacent to the south end of the dam and are respectively designated the "outlet tower" and the "Morning Glory spillway." The outlet tower connects with a discharge conduit that has an inside diameter of 20ft., and the spillway tower connects with a discharge conduit that has an interior diameter of 28·5ft. The two conduits discharge into a common stilling basin, but with a central dividing training wall that extends for half the length of the basin. The stilling is effected first by a stepped section about 110ft. long, that has a total drop of about 28ft., and the water then is arrested and slowed up by rows of staggered solid baffles of increasing height. The remainder of the 400ft. long stilling basin consists of an expanding ramp that has a climb of 10ft. to the lip, 230ft. wide, at the downstream end. The net effect of the pool, which has a depth of 40ft., is to produce a hydraulic jump that is confined between flanking reinforced concrete retaining walls. The water discharged from the conduits has a velocity of virtually 80ft. a second, and leaves the stilling basin with a velocity corresponding with that of the normal river flow.

The outlet tower, the Morning Glory spillway, the reinforced concrete discharge conduits, and the stilling basin were built in the river bed behind timber cribs that held out the river while the work was under way. The centre of the outlet tower is 495ft. upstream from the axis of the dam, and the centre of the Morning Glory spillway is 239ft. upstream from the centre line of the dam. A bridge connects the outlet tower with the Morning Glory spillway, and another bridge extends from the spillway to the upstream slope of the dam. An intermediate span at the top of the spillway connects the two bridges. The outlet tower rises 184·5ft. from the water bed to the lip at the top wall and rests upon a foundation structure set to a depth of 34ft. in an impervious clay formation known as Brule. For 160ft. of its height above the bottom of the reservoir, the outlet tower is cruciform in cross section with a cylindrical central shaft, in the lower section of which is housed a ring gate 16ft. high and 20ft. in diameter, that opens and closes four inlets that have their centres 90 deg. apart. Raising the ring gate admits water to a 20ft. outlet elbow that connects with a discharge conduit, also 20ft. in internal diameter, that runs for 965ft. to the stilling basin on the downstream side of the dam. Each of the four portals at the bottom of the outlet tower is equipped with a tractor gate, that may be closed so that the tower can be drained to permit inspection and servicing of the ring gate. Outside each tractor gate stop logs can be used to close the intakes, if need be. At its top the outlet tower has a control room in which are installed two diesel-driven plants and all necessary operating machinery. There is also a revolving hoist above the roof of the control room for handling tractor gates.

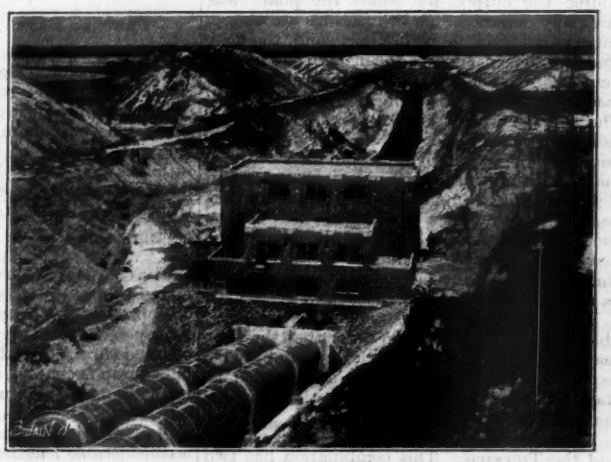
The Morning Glory spillway, also a reinforced concrete structure, consists of a cylindrical supporting body, 101ft. in diameter, that houses the upturned funnel and connecting shaft of the spillway, the lip of which is designed to lie 16ft. below the normal water surface of McConaughy Lake. The mouth of the funnel has a diameter of 90ft. Above and surrounding the lip of the spillway there is a crown structure of steel and reinforced concrete that carries twelve roller gates. These gates are raised and lowered, as required, by two electrically operated travelling cranes running on a circular track at the top of the crown structure, which has a height of 36ft. From the underside of the foundation of the Morning Glory spillway to the top of the tower the height is 172ft., the operating platform or floor having the same elevation as the roadway on the crest of the dam. While the dam was building, the elbow of the spillway funnel remained open where it joined the discharge conduit that was extended upstream beyond the spillway tower for a distance of 60ft. to an intake basin temporarily provided to control the flow of water entering the 28·5ft. conduit, while the latter functioned as a diversion tunnel. The elbow has since been blocked off from the upstream section of conduit by a massive plug of concrete reinforced externally with ring girders of steel. The outside cylinder and the inside funnel of the Morning Glory spillway are tied together with concrete and structural steel braces as well as with concrete walls, and the intramural voids within the lower two-thirds of the supporting tower are filled with ballast concrete in the lower half and vibrated gravel in the upper half. The top third of the voids is filled with sand gravel. Screened drains pierce the outer shell of the tower at intervals of 20ft. vertically to permit the admission of water to the ballast. The foundation of the spillway structure, like the foundation of the outlet tower, is embedded in impervious Brule.

During the construction of the 20ft. and the 28·5ft. conduits, the Brule was excavated so as to serve as the outside form for the lower half section of each conduit. The transverse joints in these conduits are spaced from 40ft. to 48ft. apart, and are of the bell-and-spigot type, with positive water seals obtained by the use of 48 oz. copper bellows type expansion joints. The joints, embedded in the Brule, form absolute ties between the conduits and the clay foundations. Each joint has a grouted seal at the inside surface of the conduit, the closure being made after each conduit trench had been back-filled and the sections had taken their shrinkage. Because the control gates are at the upstream end of each conduit, the internal pressure is always less than the external pressure. During the placing of the closure plug at the elbow of the spillway funnel, a temporary cofferdam was erected around the intake of the upstream spur of the conduit to shut out the flow of the river, which, for the time being, was diverted entirely through the conduit of the outlet tower. The intakes of this tower are equipped with trash racks and screens. The outlet tower will be the usual means of controlling the discharge of water downstream from McConaughy Lake in order to maintain the required flow when the river is not at flood stages. At flood stages the Morning Glory spillway will come into action. The normal water level of the basin will be at El. 3270, and extreme high water in the reservoir will be 12ft. higher; the crest of the dam is at El. 3289·75. A diversion channel carried the river flow to the outlet tower and the conduit of the spillway while the dam was being built.

An emergency spillway will be constructed in the hills south of the dam. The cill, 300ft. long, will be at the elevation of the normal water surface in the reservoir, and water passing over that spillway is to be discharged into a canal leading to a rock-walled canyon from which it will be dropped to the floor of the river valley at a point about three-quarters of a mile downstream from the toe of the dam. According to calculations, checked by hydraulic model tests, with the reservoir at normal level, the outlet tower should be able to release 25,000 cubic feet per second, and the Morning Glory spillway should be able to discharge 54,000 cubic feet per second. The dam is designed to impound water to a depth of 12ft. above the normal



OUTLET TOWER AND SPILLWAY TOWER



JOHNSON CANYON POWER-HOUSE

surface of the basin, then leaving a freeboard of 10ft. to the top of the reinforced concrete wave wall. This increased depth of 12ft. will add 500,000 acre-feet to the capacity of the reservoir. The maximum discharge at this higher level will total 82,000 cubic feet a second, not including the 50,000 cubic feet a second calculated for the emergency spillway when the reservoir will have its maximum elevation. The combined capacity of the outlet tower, the Morning Glory spillway, and the projected emergency spillway will be 132,000 cubic feet a second, substantially five times the maximum recorded flow of the North Platte River.

(To be continued)

Production of Uniform Steel for a Light Castings Foundry

By C. H. KAIN and L. W. SANDERS*

THE methods outlined in this paper are employed in one foundry producing 95 to 100 tons of finished carbon steel castings weekly. Although this is a modest tonnage, it is just double the output for which the plant was originally designed. As the castings are almost entirely light and made in green sand, the floor space must be utilised to the utmost for the production of moulds. A typical week's output was made up of over 5000 castings, totalling 97 tons. The average weight is 38 lb., with very occasional castings falling in the hundredweight and upward class. This output can only be maintained by careful planning and working to a predetermined programme. The planning is based on the number of moulds which can be produced in a given time by the equipment installed. The core output is adjusted to suit this, the moulds finished, cored up, and closed as made.

It is then necessary to have liquid steel available to pour the moulds, in order that the floor may be cleared and the cycle repeated. This paper is a description of the steps taken to standardise steel production so that moulds may be poured when ready.

Two processes are in use, the basic electric and the Tropenas. This combination has two great advantages:—

(1) The basic electric can use a wide range of scrap and produce a low-phosphorus/low-sulphur metal, the remelt from which can be used in conjunction with West Coast hematite in the Tropenas to produce steel with a phosphorus and sulphur content comparable with electric steel.

(2) The electric furnace can be adjusted to produce a heat of steel at precise intervals (of four hours in this case), day and night, whilst the Tropenas can produce heats at high speed during the peak casting period, which in most foundries is during the afternoon.

As there are so few castings of large weight, it is not possible to open up the nozzle on a mould of several hundredweights capacity, and, if it were possible, it would be undesirable, as the standard steel is at much too high a temperature for heavy castings. Hand shanking from both types of furnaces is practised to a great extent, small moulds being poured in this manner without difficulty. Table I shows the time-table which is worked in the foundry under consideration, and each process is considered in three phases, as shown in Table II:—

TABLE I.—Tapping Times

Electric furnaces. A.	B.	Converter.
2 a.m. ...	— ...	1.30 p.m. Soft
6 a.m. ...	— ...	2.15 p.m. Hard
— ...	9 a.m. ...	2.45 p.m. Soft
10 a.m. ...	— ...	3.15 p.m. Soft
— ...	1 p.m. ...	4 p.m. Hard
2 p.m. ...	— ...	4.30 p.m. Soft
6 p.m. ...	5 p.m. ...	5.15 p.m. Soft. Delayed to permit 5 p.m., heat from B
10 p.m. ...	— ...	—

TABLE II.—*Division of Processes*

Electric furnace.	Tropenas converter.
1. Charging and melting	Melting and desulphurising
2. Oxidising (converting and slagging off)	Blowing (converting)
3. Reducing (refining) Finishing and tapping	Finishing and tapping

Table III shows the standard time-table which is aimed at for both processes:—

TABLE III

Electric furnace.	Time.	Converter.	Time.
	a.m.		p.m.
Previous tap complete	9.0	End of heating period	12.45
Fettling furnace complete	9.15	Fettling complete	12.57
Charging complete ...	9.45	Charging complete	1.0
Melting complete ...	11.45	Blowing complete	1.22
Slagging off complete	11.50	Finishing and recarburising ...	1.25
	p.m.		
Finishing complete ...	12.50	Ready to tap ...	1.28
Ready to tap	12.55	Tap complete ...	1.30
Tap complete	1.0		

It is not proposed to deal in detail with the chemistry of the processes, as both are fairly well known, but to describe the mechanism of standardised steel production.

PART I: BASIC ELECTRIC PRACTICE

The furnaces in use are of the electro-metals type, with two top electrodes and a conducting hearth. They are rectangular in shape with nut and screw-operated tilting and elevating gear. The maximum capacity is 50 cwt. and charging is entirely by hand. The nominal rating is 650 kVA. The basis of the process lies in standardisation of the charges, a controlled boil and speed in working.

CHARGING AND MELTING

The charge is made up of 45 cwt. to 47 cwt. of mixed cold scrap of variable size and consisting of approximately 75 per cent. scrap and 25 per cent. steel turnings. The heavy scrap is charged first, directly under the electrodes, light scrap is charged around the electrodes and in the centre of the furnace, and the steel turnings round the sides. It is found that even slight variation from these proportions causes a considerable lengthening of the melting time. Thus an increase to 30 per cent. for the turnings increases the time of a heat by 15 min. The time taken to charge the scrap is between 20 min. and 30 min., according to the size. The heavier scrap takes longer than the medium variety, which can be readily handled by shovels.

The aim is to melt from the bottom upwards, the arc being concentrated on the heavy scrap to form a pool of metal quickly. By this means a constant arc is maintained. Lime is added with the charge, about 75 lb. to the ton being used. This quantity is varied according to the condition of the scrap, dirty or rusty scrap receiving more and high-quality material rather less.

Melting is conducted as rapidly as possible with a load of 5000 amperes at 80 to 85 volts. The time taken to melt a charge of 45 cwt. to 47 cwt. from the cold is usually 2 hours. During the melting period care is taken to prevent excessive heat in the centre of the furnace by frequently pushing the charge towards the centre. This prevents over-oxidation or direct attack by the arc on the furnace bottom. Further lime is added from time to time to form slag. When the bath is all clear-melted, the temperature should be just high enough to ensure a liquid slag under normal conditions.

OXIDISING AND SLAGGING OFF

The temperature is increased as additions of broken ore are made to remove the oxidisable elements. Properly worked, a bath condition arises when a critical temperature is reached and a violent boil takes place. It is essential that this boil be secured. A short and vigorous boil is preferred to a long slow boil, carbon being reduced from approximately 0·38 to 0·09 per cent. in 10 min. This short vigorous boil on a rising temperature gradient appears to be a crucial point in successful practice. Thus, if no boil takes place, the slag is glassy and reflects heat, causing the roof to run and making the later formation of a true reducing slag very difficult. Also the absence of a boil appears to be associated with sluggishness in the finished steel.

A long slow boil at constant temperature leaves a bath which is very difficult to kill and which wastes a great deal of time during the finishing period. The essentials are to melt a bath with sufficient carbon (0·35 to 0·45 per cent.) to cause a strong boil, to feed ore slowly and steadily whilst the temperature is raised, and not to cause boiling at a low temperature by considerable stirring or rabbling. Immediately the boil has died down and a test shows a soft bath, a sample is sent to the laboratory for phosphorus estimation. The first slag is now poured off and a fresh lime slag put on. Fairly strong oxidising conditions are maintained until the laboratory report is favourable.

At this stage, carbon, silicon, manganese, and phosphorus are reduced to a minimum, and are present in approximately the following quantities:—C 0·09, Si 0·008, Mn 0·10, and P 0·015 per cent. There is no reduction of sulphur during the period of melting and oxidising. The slag at this stage is quite black and inclined to brittleness after cooling, containing CaO 40, FeO 24, SiO_2 17, MnO 4, P_2O_5 0·9 per cent.; Al_2O_3 remainder.

REMOVAL OF THE OXIDISING SLAG

After the elimination of the carbon, silicon, manganese, and phosphorus, the bath is ready for the removal of the oxidising slag. The removal is carefully supervised, as the slag is carrying phosphorus, and, under the reducing conditions which follow, this would revert to the metal. Slagging is conducted as follows:—The furnace is slightly tilted and the slag poured or lightly raked off; the load is then taken off and the electrodes raised. A little lime is added to thicken the slag, which greatly facilitates the slagging operation, and care is taken to remove all traces of slag from the sides and banks of the bath.

Skimming is conducted as rapidly as possible in order that heat should not be lost during this period. When the bath is in good condition, the complete removal of slag is accomplished in 7 min. or 8 min. To the slag-free bath is added 10 lb. per ton FeSi to quieten the metal, which aids in producing a more uniform recovery when recarburising takes place for higher carbon steel.

Refining, Finishing, and Tapping.—In the case of low-carbon steels, no carbon is added at this stage, but for high-carbon steels 20 lb. of anthracite duff is thrown into the bath, followed immediately by one-half the total ferro-manganese addition. The bath is now ready to take the refining slag, which consists of 50 lb. of lime, 20 lb. fluorspar, and 7 lb. coal dust. The load is again introduced and refining begins. The total refining time is approximately one hour, half of which is taken in forming the slag and the rest in deoxidising and acquiring heat.

Low power input at 3500 amperes at 85 volts is used at first, when the slag is quite black in colour, and after about 10 min., as the slag begins to melt, a small amount of FeSi is added, which hastens deoxidation. During this period the consistency of the slag is carefully observed, not being allowed to become too viscous or too thin. When the slag is too thick, contact with the metal is not made, and sulpuur elimination does not proceed efficiently. If it becomes too thin, serious softening of the roof and walls takes place.

The slag is worked up to strongly reducing conditions by the addition of lime and coal as required, and at this stage is white in colour, with a strong smell of acetylene, denoting the presence of calcium carbide. At this point the power input is increased to 4000 amperes. Spoon samples are taken for general conditions of the steel and the metal quietened by small additions of FeSi. All samples during the refining period are taken with a cold spoon freed from metal and slag before use. The spoon is carefully warmed and slagged before dipping into the bath. Care is used to take the samples

*The Institute of British Foundrymen, June 20th, 1942.

from the same position in the bath. When the metal is hot enough and the slag in good condition, a sample is taken for carbon. Final adjustment is made with hematite, and additions of 45 per cent. FeSi and 80 per cent. FeMn are added to bring these elements to the desired quantity. The additions of FeSi and FeMn are calculated from the known weight of metal in the bath.

The additions are allowed to melt and the bath well rabbled with a bar before a sample is poured into a sand mould. This sample should be quiet and piping. The load is then taken off and the metal allowed to stand two or three minutes before tapping, to enable the slag to separate. The slag being highly basic and reducing conditions properly controlled, sulphur is efficiently reduced from 0·050 to 0·014 per cent. Tapping takes place through a tap hole built up with sand outside the door. Although this is a somewhat lengthy procedure, it prevents the slag from running with the metal, and avoids serious variation of carbon content and inclusions of non-metallic material. The metal is tapped into bottom-pouring ladles, which are preheated by gas burners to approximately 800 deg. Cent., and aluminium is added as the bottom of the ladle becomes well covered. The tapping temperature for shanking steel is in the neighbourhood of 1650 deg. Cent., and for direct-pour heats approximately 1580 deg. Cent. Details of pouring times and temperatures are given in Table IV. Unit consumption is at

TABLE IV.—*Electric Steel Tapping Temperatures and Times*

Electric furnace.	Shanking heats. Deg. Cent.	Bottom pouring heats. Deg. Cent.
Tapping temperature ...	1650	1580
Temperature, first pour	1600	1560
Temperature, last pour	1560	1530
Time pouring	25 min.	20 min.
No. of moulds	80	67
Weight of metal cast ...	47 cwt.	45 cwt.

the rate of 869 per ton, inclusive of coke-load and preheating. The temperature readings are taken with a Foster optical pyrometer, looking on to a clean stream of metal, and a correction of 7 per cent. added.

PART II: TROPENAS CONVERTER PRACTICE

DESCRIPTION OF PLANT AND CONVERTER LINING

The equipment in use consists of one 20-cwt. (nominal) Tropenas converter, with a positive Rootes blower to furnish air; one balanced-blast cupola, 27in. diameter, capable of melting 3 tons of iron per hour, and one 2-ton capacity ladle for receiving the cupola iron for transfer to the converter; one lip-pouring ladle from which steel is hand-shanked, and several bottom-pouring ladles, all of which are preheated by gas burners. The vessel is nominally of 1-ton capacity, but the first charge is never less than 27 cwt., and this increases as the lining wears. The lining is 8in. thick, except at the tuyeres side, where it is 11in. There are five 1¼in. diameter tuyeres formed in the rammed lining, for which a proprietary material is used. It is essential to control the moisture content at 8 per cent. during ramming, and to take steps to secure adequate drying and preheating before the first charge. The average life of a lining is seventy blows. The time-table is based upon a standardised converter charge, uniform vessel temperature and controlled blowing conditions. The tuyeres must be perfectly perpendicular to the axis of the vessel, an error of a degree or so prolonging the blow 5 min. to 8 min., and yielding cold steel.

MELTING AND DESULPHURISING

The cupola is fettled and patched each morning, this operation taking roughly 2 hours. The sand bottom is rammed up and a fire started, which is allowed to burn through steadily without forced draught, and in about 2 hours charging begins. As small converters cannot easily be held to size, no patching of the vessel takes place, and the capacity of the vessel increases during the week. Under these conditions a standard cupola charge of constant weight cannot be maintained without seriously modifying the chemical composition of the iron charged to the vessel.

To avoid variation of chemical composition in the charge to the converter, the cupola charges are adjusted. Experience has shown that the converter weight increases along the following lines:—At the beginning of the week 27 cwt. are required, and, as little wear takes place during the first two days, three cupola charges of 9 cwt. to the blow suffice. After the second day the weight increases by 1 cwt. to 28 cwt., and four cupola charges of 7 cwt. are used. For the fourth day the converter weight will have increased to 30 cwt., and three units of 10 cwt. are used.

TABLE V.—*Cupola Charge Sheet*

	No. of cupola charges in converter charge.	Weight of cupola charge.	Total converter charge weight.
		Cwt.	Cwt.
Monday	3	9	27
Tuesday	3	9	27
Wednesday	4	7	28
Thursday	3	10	30
Friday	3	10	30
Saturday...	4	8	32

Table V shows the cupola charge details for the full week. In this manner a uniform composition is obtained without difficulty, as the following figures for six blows testify:—

T.C., per cent., 3·19, 3·03, 3·11, 3·03, 2·95, 3·00.

Si, per cent., 1·41, 1·41, 1·41, 1·35, 1·41, 1·13 (Si reduced).

The charges consist of 70 per cent. steel foundry scrap and 30 per cent. hematite pig iron, the silicon being adjusted by the use of 45 per cent. FeSi to give a final silicon of 1·4 to 1·50 per cent. The coke used is of the Welsh variety, coke to metal ratio being 1 : 10. Chalk containing 55·0 per cent. CaO and having a moisture content of 1·96 per cent. is used instead of limestone, 25 per cent. chalk to coke by weight being used. Melting losses, despite the sandy nature of the scrap and pig, are constant at 5 per cent. Charging takes place immediately the bed has been made up, and as the cupola is hand-charged, the steel is charged first and the pig charged round the sides. Charging is completed in 40 min. The tuyeres of the cupola are set at a height that enables the cupola operator to secure enough metal for the converter in two taps. The taps run at regular intervals of 15 min., with intervals of 5 min. or 6 min. between each converter charge, during which time the tuyeres are cleaned and the slag hole made up. Hot iron is secured from the cupola, the temperature being 1460 deg. Cent. (optical pyrometer).

Soda ash is used for desulphurisation, 1 lb. of sodium carbonate to 1 cwt. of metal being added to the receiving ladle before tapping. When the metal is tapped a violent reaction occurs, and heavy fumes are given off; after the second tap the reaction occurs again. Sulphur reductions as shown by recent analysis are as follows:—

Cupola, S, per cent., 0·071, 0·080, 0·068, 0–078, 0·067.

Ladle, S, per cent., 0·032, 0·037, 0·035, 0·035, 0·029.

When the metal has come to rest the ladle is removed from the cupola pit and the metal skimmed ready to be poured into the converter.

BLOWING (CONVERTING)

After desulphurisation the weight of the metal is checked and poured into the converter, which is in the charging position. The vessel is run up and the level adjusted by the operator. Blowing always takes place on the same angle. A quadrant is attached to the vessel clearly showing the angle, divisions of 5–10–15–20 deg. being shown by a pointer which revolves with the vessel. Blowing takes place on the 15-deg. mark. After the level is adjusted the blower is started and blast at 4 lb. per square inch pressure introduced, the operator records the time on a board, and the blow is on.

A normal blow is as follows:—As the blast strikes the bath, light yellow sparks and a small flame, going straight up the hood, proceed from the mouth of the converter. In about 5 min. a reddish brown flame appears directly over the tuyeres. This spreads and develops in length and marks the beginning of the ignition period. At this stage any FeSi that may be considered necessary is added to the converter in lumps 3 min. after ignition, then flame attains its full height, and a vigorous boil ejects a little slag and metal from the mouth of the vessel. At this point the blast pressure is gently reduced to 3 lb. per square inch, and the vessel "moved up into the wind."

It is not considered good practice to reduce the blast pressure rapidly, as sudden reduction results in the loss of the flame. By the time the boil occurs, the bulk of the silicon and manganese have been oxidised, together with the small amount of iron which pass into the slag as silica, manganese oxide, and iron oxide respectively. After reducing the blast, the flame remains steady, being "solid" and having length, until about 12 min. after ignition, when the carbon flame ascends voluminously and intensely white in colour. As the carbon becomes exhausted the flame becomes streaked and diminishes in length. At this point the converter is turned down; the blow is completed.

The bath at the end of the blow is in a highly oxidised condition, containing approximately, C 0·08, Mn 0·005, and Si 0·008 per cent. No reduction of sulphur or phosphorus takes place, and actually a slight increase of these elements occurs, owing to the blowing loss, which is roughly 8 per cent. The practice of adding FeSi to the converter is only used when metal is to be hand-shanked. It is found that additions of FeSi have a pronounced effect upon the action of the flame, usually two or more boils taking place, and, in the closing stages of the blow, it is not unusual for several false drops of the flame to take place before the carbon is finally exhausted. With such inconsistency of flame, the possibility of under or over-blowing is considerable.

FINISHING AND TAPPING

After the converter is turned down, deoxidisation takes place by the addition of 45 per cent. FeSi and 80 per cent. FeMn. The FeSi at the rate of 12 lb. per ton or 25 per cent. is added in tins, the slag being pushed away from the metal and the tins thrust into the bath. The FeMn addition is made by dipping the lumps in water and throwing them with force through the mouth of the converter, relying on the wet manganese to explode the covering of slag and penetrate into the metal. The loss of manganese is approximately 20 per cent., 1·20 per cent. being added to finish at 1·0 per cent. The metal is then well rabbled with a bar to work in any manganese that may have been trapped by the slag.

The carbon is adjusted, when necessary, by the use of cupola metal. This method of recarburising is easily adaptable, quick and efficient, hot hand shanks of predetermined capacity being used. The actual time taken to recarburise a heat is 3 min. After recarburisation, the vessel is turned up to within a few degrees of the blowing position (in order to obtain the maximum movement of the metal), and back again to the pouring position, then rabbled well with a bar to ensure homogeneity. The ladle is brought into the pit and the slag is held back to ensure that the aluminium which is added to the ladle will be taken up by the metal, after which the slag is allowed to run freely. The tapping temperature of converter metal compares favourably with electric furnace metal. Shanking heats are tapped at 1660 deg. Cent. and bottom-pouring heats at 1600 deg. Cent. Table VI gives details of pouring temperatures and times:—

TABLE VI.—*Converter Steel Pouring Temperatures and Times*

Tropenas converter.	Shanking heats. Deg. Cent.	Bottom pouring heats. Deg. Cent.
Tapping temperature ...	1660	1600
Temperature, first pour	1630	1560
Temperature, last pour	1575	1530
Time pouring	25 min.	20 min.
No. of moulds	88	75
Weight of metal cast ...	32 cwt.	30 cwt.

APPENDICES

LINING AND PREHEATING OF ELECTRIC FURNACE

Lining.—The side walls and arches of silica

bricks are built into position. The bottom is then made up as follows :—One inch of ground magnesite is spread over the bottom next to the shell, over which is laid one course of 3in. magnesite bricks, a further 1in. of ground magnesite spread over the bricks, followed by 2in. of fine dry dolomite. The actual melting hearth consists of dolomite bonded with tar, rammed into place with pneumatic rammers. The tar is dehydrated (0·5 per cent. maximum H_2O) and 8 per cent. by weight of tar to dolomite is used. The tar and dolomite are preheated before mixing, and are rammed into the bath cold. The roof is built with silica bricks.

Preheating.—Coke is charged into the furnace and a load of 2000 to 2500 amperes at 80 volts is maintained. About 72-hour heating is necessary to bring the bottom or neutral current into operation in a new furnace. Preliminary heating prior to the week's campaign is similar to the above, with the heating time reduced to 6 hours.

Preparation of Converter Vessels

The bottom of the converter vessel is made up of three courses of 3in. silica bricks. A well-known proprietary material is used for the walls, which are rammed round a wooden former, 27in. across by 51in. high, sectional in construction to facilitate removal. The vitrified and burnt material is chipped off the face, leaving about 1½in. to 3in. old material round the shell. This is slurried down and the new material rammed into place with pneumatic rammers. The vessel is allowed to stand, drying naturally for as long as possible before being put into work.

Drying and heating are conducted as follows :—A small coke fire is started and allowed to burn slowly for 15 hours, additions of coke being made as required. After 15 hours, approximately 5 cwt. of coke is added and air blown in through the tuyeres at 1½ lb. per square inch pressure. After blowing once up and down, a further 2 cwt. of coke is added, and the blowing repeated. Blowing up and down is maintained for 30 min. in each operation. The vessel is then allowed to hang nose downwards with the tuyere box open. The daily practice is similar. After the nose has been made up, a fire is started at 8 a.m. and alternate blowing up and down the hood takes place at 30-min. intervals. The vessel is then turned down until the coke is withdrawn. Coke consumption increases as the size of the vessel increases, and reaches a maximum of 10 cwt.

Physical Properties

Table A details the chemical composition

Table A.—*Properties of Steel made by the Two Processes*

	Basic electric furnace.		Tropenas converter.	
Heat No.	C 10970	B 3448	F 9261	F 8349
Composition, per cent.—				
C	0·20	0·41	0·18	0·33
Si	0·25	0·33	0·22	0·35
Mn	0·85	1·10	0·85	1·10
S	0·020	0·020	0·032	0·032
P	0·015	0·015	0·037	0·037
Physical properties—				
Y.P., tons per sq. in. ...	20·8	24·75	17·20	20·00
U.S., tons per sq. in. ...	32·75	41·55	32·00	35·55
El., per cent.	39	25	36	24
R.A., per cent.	40	45	56	30

and physical properties of the steels after normalising from 900 deg. to 920 deg. Cent.

Fluidity

The question of the relative fluidity of converter and basic electric steel is often discussed. It is usually held that converter steel is more fluid than basic electric steel. In the experience of the authors, temperature is by far the strongest factor in fluidity. Temperature readings over a considerable period have shown that converter steel is consistently 40 deg. to 60 deg. Cent. hotter than electric steel. It is their opinion that with well-made steels the difference in fluidity of the two types of steel at the same temperature is very small.

Non-fluid steels are occasionally encountered and, in the case of electric steel, this is usually found to occur in heats on which the boil has been unsatisfactory. This is often followed by a prolonged period under the final reducing slag. The steel is frequently found to be high in Si and to contain considerable inclusions. In no discussion on fluidity has any reference been found to non-fluid converter steel. Yet this occasionally occurs. It appears to be associated with cold iron in the converter charge and an extended period before the boil begins. A very fluid and sloppy slag high in FeO is formed, and it appears that this results in a high proportion of non-metallic inclusions. It would be interesting to know if there is any definite evidence that lack of fluidity is associated with the presence of inclusions.

Precision Pipe Bending

Reference was recently made in our issues of April 3rd and 10th to a new technique in precision pipe bending by special press methods developed by Blackburn Aircraft, Ltd. The examples given in those articles covered pipes of up to 1½in. diameter, such sizes including the majority of pipe work required for aircraft and light engineering work. The scope of the process is not limited to this

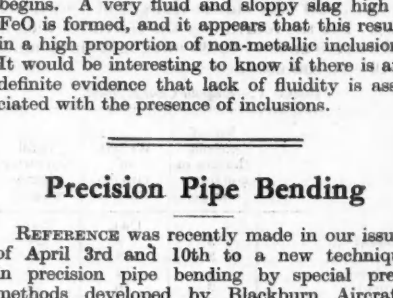


Fig. 1—Pipe in Dies for First Operation

size of work, however, and an interesting example of the application of the process to larger diameter pipes is shown in the accompanying engravings.

In this example the pipe is 2½in. outside diameter, 20 gauge, and 2ft. 3in. in length, the material being "Tungum." The bends are in two planes, necessitating the splitting of the work into two operations carried out in separate fixtures. Fig. 1 shows the pipe in the dies at the commencement of the first operation. The pipe is, of course, carefully filled or loaded before bending, the material used being "Cerrobend" low-melting-point alloy. The illustration shows the construction of the tools,

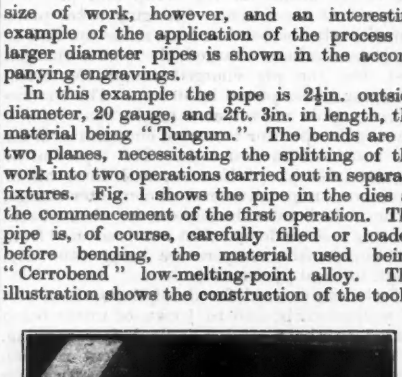


Fig. 2—Pipe in Dies for Second Operation

which are largely of wood, the upper portion, or "punch," sliding in grooves cut in the lower or die portion. To avoid side movement of the pipe it is clamped to the upper bending tool or punch at the centre by means of a split fibre "bearing," which is held in position by means of a steel strap.

The first operation imparts two bends of an "S" form to the pipe. The pipe is then withdrawn from the fixture and clamped in the second die, shown in Fig. 2. Here it is located and clamped by two bridge clamp plates with hardwood pads cut to form (one of which is shown removed and resting on the top of the die). The bending tool is inserted in its slide, as shown to the left of the figure, and pressed home, thus turning one of the bends already imparted into its correct plane.

The completed pipe is shown resting on the checking fixture in Fig. 3. This fixture, in addition to providing the means for checking for correct form, also provides a simple method for marking off the pipe to its correct length by reference end plates. To complete the part, the "Cerrobend" filler is removed in the usual way, ends trimmed and nipples brazed on. The carpenters' rule gives an idea of the relative

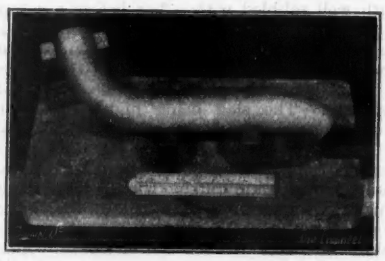


Fig. 3—Completed Pipe in Checking Fixture

sizes of the work and tools. For the sake of clearness the pipe in the photographs is shown with the filler removed.

Although the bends in this component are relatively simple, the saving in time as compared with hand work is very marked, the production time by the Blackburn machine method being, it is said, approximately one-third of the time for hand bending. These times include all operations in the work common to the two methods, *i.e.*, filling, emptying, cleaning, trimming, brazing on nipples, &c., for which, of course, production time does not differ. A further saving accrues, of course, from the fact that the Blackburn process does not call for skilled labour.

The Agricultural Machinery Development Board

At a conference held at the Ministry of Agriculture on Friday, July 3rd, Lord Radnor gave an account of the work of the Agricultural Machinery Development Board, which, following a report from the Agricultural Improvement Council, was set up by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, at the beginning of the year. The membership of the Board was drawn from progressive farmers familiar with the problems of mechanisation, the manufacturers of agricultural machinery and implements, and representatives of the agricultural labour organisations, together with representatives of the Department of Scientific and Industrial Research and the Agricultural Research Council. At the present time the Committee consists of eighteen members. Of these, the Chairman and the President of the National Farmers' Union, along with six farmers, represent farming interests, while engineering is represented by four of the largest firms engaged in the manufacture of agricultural machinery in England and Scotland. Two representatives of agricultural labour organisations sit on the Board, and there are as well a representative of the Agricultural Research Council, the Superintendent of the Engineering Department of the National Physical Laboratory, and two other members who have had great experience with the work of county agricultural education and advisory work. The duties of the Board, among others, include the making of arrangements for the testing of agricultural machinery and implements, dealing with such matters as uniformity and standardisation of designs, and the provision of educational and advisory facilities on all questions affecting the mechanisation of British agriculture. In order to discharge these important duties the Board requires a highly qualified staff of agriculturists and engineers with adequate workshop facilities and testing grounds, and to meet these demands a National Institute of Agricultural Engineering has been formed, with headquarters at Askham Bryan, near York, as recorded in a Seven-Day Journal note in this issue.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

Tungsten Steel Scrap Order

The Ministry of Supply has issued the Control of Iron and Steel (No. 24) (Scrap) Order, 1942, which comes into force on July 24th. The new Order renders it compulsory for any person having scrap steel containing tungsten in his possession to (*a*) decide upon some place in each of his premises, in which such scrap may be, as the place in those premises where scrap steel containing tungsten is to be kept; and (*b*) keep such scrap segregated from all other scrap. It is suggested that persons affected by the Order should place some receptacle in the appointed place, such as a bin, and notify all employees that all scrap steel containing tungsten must be placed in the receptacle. The Order does not prohibit or restrict the owner of scrap steel containing tungsten from disposing of it, provided, of course, the person acquiring is licensed to do so under the Control of Iron and Steel (No. 14) (Scrap) Order, 1940, and the sale price is within the controlled maximum prices. As from the date of the Order coming into force, existing licences (8 series) held by scrap iron and steel merchants will cease to authorise the acquisition of scrap containing tungsten. Special licences for the acquisition of such scrap will be issued to merchants. The prefix "W" will be used on such licences. In addition, the Order further varies the Control of Iron and Steel (No. 14) (Scrap) Order, 1940, by fixing the maximum price for high-speed steel solid scrap containing 5 per cent. to 6½ per cent. tungsten and 5 per cent. to 6½ per cent. molybdenum at 9d. per pound and for high-speed steel turnings of a similar specification at 5d. per pound. It will be remembered that a few weeks ago the Iron and Steel Control appealed to the managements of works using tungsten steel to impress upon the workpeople the necessity for collecting and segregating tungsten high-speed steel scrap arising in the course of their operations. The foregoing Order merely makes compulsory the request then made by the Control.

The Pig Iron Market

Interest in the pig iron market centres chiefly upon the effect on the pig iron prices of the advance in the prices of industrial coal. It is obvious that the increase in miners' wages will add to the costs of iron and steel producers, who at the moment are prevented from increasing their quotations by the operation of the Maximum Price Orders. It is improbable, however, that any increase in current maximum prices will be made for some time. Steady conditions appear to be developing in the pig iron trade, and whilst the demand for foundry pig iron shows a tendency to become more stable, the pressure upon certain descriptions of pig iron is unrelaxed. The hematite position remains difficult, and this pig iron is not released by the Iron and Steel Control except where its use is necessary. This throws a heavier demand upon refined irons and the position is somewhat tight, although consumers engaged upon war work receive the supplies they require. On the North-East Coast the pig iron producers are concentrating principally on the production of basic hematite and refined irons and the output of Cleveland foundry is insignificant. The output of the Cleveland ironstone mines has been largely increased, but it is being fully taken up by the blast-furnaces in the district and is also supplemented by supplies from the Midlands. In the Midlands there is a considerable production of high-phosphoric pig iron and the stocks of the furnaces are said to be large. The demand, however, is principally for higher-quality irons, although high-phosphoric iron is used for many purposes for which consumers would formerly have required another description. The production of refined and low-phosphoric pig irons has been considerably increased of late and the Iron and Steel Control is exercising great care in the distribution of pig irons below 0·7 per cent. phosphorus. The situation in the foundry trade has led to a greater use of cast iron scrap and there has been a corresponding decline in the demand for foundry pig iron. Fortunately, the raw materials position is satisfactory and supplies of foundry coke are coming forward in adequate quantities.

The Midlands and South Wales

The end of Period II was marked by the usual rush to secure the completion of orders placed during the quarter and, as a matter of fact, comparatively few contracts were uncompleted at the end of June. At the same time, there has been considerable activity on the part of consumers in placing fresh business to cover their allocations, and most of the steel works already carry good order books for Period III. The raw materials position is satisfactory and the production of steel is maintained at a high level. The chief features of the demand are, as they have been for some months, the heavy pressure to obtain plates and the call for alloy and special steels. The requirements of the shipyards seem unending and large tonnages are also passing to the tank makers, whilst the armaments and the munitions and aircraft manufacturers supply the chief outlets for special steels. The re-rolling industry is actively employed and producers of bright-drawn steel and cold-rolled strip in particular are working under heavy pressure. The demand for light sections and small bars shows no signs of relaxing and the re-rollers producing this material have a considerable tonnage of work in hand and in prospect. The consumption of heavy joists and sections remains poor and many of the structural engineering concerns which provide an outlet for this class of material are working well below capacity. Recently there has been a tendency for the demand for colliery steel to strengthen. The South Wales iron and steel industry is fully employed and the third delivery period of the year has brought a large tonnage of orders to practically all departments. Business in billets is on a heavy scale, but satisfactory deliveries are being made by the Welsh producers. There has been a decline, however, in the call for sheet and tinplate bars owing to the restrictions upon the production of sheets and tinplates. A brisk demand exists for black and painted sheets and for uncoated plates.

The North-East Coast and Yorkshire

The production of steel on the North-East Coast has reached a high level, but the demand is unrelaxed and the output finds its way into almost immediate consumption. Pressure upon the producers is therefore maintained; but, in spite of occasional difficulties, the firms engaged upon war work are receiving adequate supplies. A certain amount of material continues to be received from the United States and these imports principally consist of semis and special steels, which are required in an increasing quantity. The re-rolling industry is in a good position with regard to raw materials and outputs are on an important scale. There is a brisk demand for the smaller sizes of structural steel, although the request for steel bars shows signs of tapering off. On the other hand, there is a steady call for reinforcing concrete rods. There has been no improvement in the demand for heavy joists and sections and most of the producing works could deal with substantially more work than than they have upon their books. The sheet makers are kept well employed, although activity in this branch of the industry is not more than moderate. Considerable tonnages of black and painted sheets continue to pass into consumption, but galvanised sheets can be made only on special authorisation. Business in plates has been maintained to an unusual degree and large tonnages continue to pass to the shipyards, the demand from this quarter looking as though it might continue for an indefinite period, as a considerable building programme is in hand at the shipyards as well as a large amount of repair work. Colliery managements are still experiencing difficulties from the shortage of wood and are turning more and more to steel, with the result that the demand from the mining industry is on a heavy scale. The steel works in Yorkshire are producing at a high rate of capacity. The volume of business in alloy and special steel appears to be increasing, and as most of the orders for this class of steel are of high priority, there is no relaxation in the pressure upon the works. The use of substitute steel for high-tungsten steel is proceeding without any particular difficulty arising. A heavy demand for stainless steel has ruled for some time, and the Control is exercising great care in its distribution. Parcels are only released when no substitute is suitable for the work in hand. There is a high production of acid carbon steel, and in this department the situation is satisfactory.

Scotland and the North

Although the holiday season has commenced in Scotland, there is no interruption in outputs, since the spread-over arrangements which are in operation are proceeding satisfactorily and production is being well maintained. The Scottish steel works are heavily engaged on the production of plates which are required in large quantities by the shipyards, whilst the tank makers and boilermakers are also using important quantities. The capacity of some of the plate mills has been taxed to the utmost for a long time, and some of the mills are finding it difficult to keep abreast of their deliveries. In these conditions it is not surprising that the period required for delivery shows a tendency to lengthen. The remainder of the production of the Scottish steel works is going almost entirely into armaments and munitions, whilst considerable quantities are being taken up by the equipment manufacturers. The next in importance probably is the demand for alloy and special steels. The works producing this material are being pressed by priority consumers and although continual efforts are being made to increase production, the position is somewhat stringent. Some of the power plants are not so busy as they were recently, but their demands continue to absorb quantities of steel. The re-rolling industry has experienced rather patchy conditions of late. There is a fair demand for small steel bars, but some works could do with more orders and the call for reinforced concrete rods is not so much in evidence as it was a couple of months ago. The volume of business in small sections also has shown a tendency to decline lately. The sheet makers are moderately well employed and there is an increasing demand for uncoated and painted sheets now that galvanised sheets are only made to special requirements. The demand for iron and steel in the Lancashire market, although on a heavy scale, is steadier than it was earlier in the year. The heavy plate position has not altered and large quantities are passing into consumption, but the demand for the light and medium varieties does not seem to be quite so pressing. Business in steel bars is well maintained and large tonnages are being taken up by the engineering industry. Their requirements appear to be chiefly for the larger diameters, but there is also a good demand for small steel bars, the producers of which have well-filled order books. The demand for alloy steels is unrelaxed, whilst an active business is passing in stainless steel. Great activity prevails at the steel works on the North-West Coast and production is maintained at a high rate. There is a particularly strong demand for ship, tank, and constructional plates, and most of the works have good orders in hand for rails.

Copper, Tin, Lead, and Spelter

The chief characteristics of the non-ferrous metal markets have remained unaltered for some time. Whilst in one direction there is a steady movement to conserve the metal by the drastic curtailment of supplies for unessential work, in all producing countries great efforts are being made to increase outputs. The tendency is for the consumption of the principal non-ferrous metals to increase and it is satisfactory that the arrangements, made by the British Government at the beginning of the war, have worked so smoothly that, notwithstanding the huge consumption, supplies have been maintained to the war industries. Large tonnages of copper are being used by the brassmaking industry, and, in fact, this trade would appear to be the largest consumer. The collection and the use of scrap is also being carried on to a much greater degree than in the early stages of the war. In the United States the use of copper for unessential purposes is rigorously controlled. An interesting transaction was announced recently when a parcel of a few hundred tons of copper in the shape of obsolete shell cases was sold as scrap by the British Ministry of Munitions. The cases, it is said, had become obsolete through the loss of equipment at Dunkirk. . . . The situation in the tin market is unchanged, but the view is taken that the arrangements made by the United Nations have largely neutralised the loss of the Far Eastern tin smelters and properties to the Japanese. The preservation of the stocks of tin in the United States and Great Britain appears to have been successfully accomplished, whilst in America the policy of economising in the use of tin is firmly pursued. The United States tinplate industry appears to be actively turning over to the electrolytic process of tinning, and the tinplate production in the first quarter of the year was higher than for the corresponding period in 1941. . . . The Non-ferrous Metal Control is careful to allow no lead to be used other than for essential war purposes, but it is believed that good stocks exist in this country. Encouragement is being given to the collection and use of scrap lead. . . . In spite of the rather stringent spelter position, adequate supplies continue to reach consuming firms engaged upon war work, whilst a similar position rules apparently in the United States. According to the United States Bureau of Mines, the production of zinc by American mines in January totalled 66,078 tons, compared with 66,218 tons in December. For some time past no spelter has been released excepting for essential purposes.

Notes and Memoranda

Rail and Road

JOHANNESBURG'S LOAN TO LONDON.—Eighteen trolleybuses built for export to Johannesburg have been added to the fleet of the L.P.T.B. Twenty-five others which were to have gone to Durban also have been acquired. These South African buses are somewhat wider than the maximum normally permitted in this country, and provide more room for the conductor to pass along the bus.

MICRO-PHOTOGRAPHIC RECORDS.—Among the big industrial concerns using micro-photography to duplicate irreplaceable records is the London and North-Eastern Railway Company, which has had its books of major importance reduced to a permanent record which can be stored with security in a small space. As an example of what can be done, a large manuscript covered with small copper-plate handwriting has been photographed on a film only 1½in. by 1in. The detail is so clear that an enlargement brings it back to the original size when required.

FINGER PRINTS FROM RAILWAYMEN.—More than 3000 employees of the St. Louis and San Francisco Railway Company have voluntarily been finger-printed under a programme instituted by the railway's finger-printing bureau. Since March last all new employees entering the service of the company are required to have their finger prints recorded. The plan was established as a service to employees and their families as a positive means of identification. One set of prints is retained in the railway's files and another is kept in the civilian identification file of the Federal Bureau of Identification.

A BRIDGE TO CONNECT TWO COUNTRIES.—Under a protocol signed in the winter of 1941, an international bridge over the Uruguay River between Argentina and Brazil is planned, and tenders have now been invited. The bridge will be 1419 m. in length and will span the river at Pas de Los Libres, on the Argentine side and the Uruguayana on the Brazilian. The cost of the complete structure will be shared equally by both countries. The bridge will consist of ten sets of arches of 140 m. each, or forty single arches of 35 m., with a central span of 19 m. The estimated total cost is over two million dollars.

INDIA AND RAILWAY STORES.—India is turning out greatly increased supplies and not only for domestic needs. Recent exports have included large quantities of track, turnouts, crossings, turntables, and miscellaneous railway stores. The track alone, in the course of a year, will have run to many hundreds of miles. Practically all this material is being manufactured in the railway workshops, whose capacity is being continually developed to meet the growing demands of the various theatres of war. Recently, during a single week, orders for railway stores valued at over Rs. 1½ crores were placed with these workshops for supply to the Near and Middle East. The items comprised rails, fish-plates, fish bolts, dogspikes, bearing plates, turnouts, and trough sleepers.

Air and Water

THE RAINBOW BRIDGE WINS AN AWARD.—The Rainbow bridge, which spans the Niagara River and was opened to traffic last November, has been judged the most beautiful steel bridge in the 1,000,000-dollar class built last year. This award is made annually by the American Institute of Steel Construction.

SHIPYARD ACCIDENTS.—The Ministry of Labour and National Service has issued a booklet showing how accidents in shipyards can be reduced. The foreword says that serious accidents are happening in shipyards at the rate of about one every forty minutes. They are unnecessary, reduce output, and are fouls in a game that means life and death to Britain.

A CIMENT FONDU PIER.—A little over ten years ago the Halifax (Nova Scotia) Harbour Commissioners were faced with the problem of replacing a harbour pier, which had, in the space of eleven years, decayed through the combined actions of sea water and ice. The chief engineer of the Commission was naturally anxious that this experience should not be repeated, particularly as the damaged pier was completely unusable. Considerable interest was aroused in Canada when a conditional order was placed with a British firm to the value of £120,000 for cement to be used in the construction of the new quarter-mile long pier. The cement chosen was Ciment Fondu aluminous cement, and the condition was that the manufacturers—Lafarge Aluminous Cement Company, Ltd.—should guarantee their claim that Ciment Fondu would not deteriorate under the severe conditions. The manufacturers agreed to deposit a heavy financial guarantee for a period of ten years. The pier was built and now, the ten years having expired, the full amount of the guarantee has been refunded without question or dispute.

CONCRETE BARGES.—The use of concrete for barges is not new, but new ground was broken at the end of May, when the keels were laid for two concrete barges on the ways of the MacEvoy Shipbuilding Company at Port Wentworth, near Savannah, Ga. The barges are to be 350ft. long between perpendiculars, 366ft. overall, and have a 54ft. beam and a total depth of 36ft. Displacement will be about 12,000 tons at 28ft. draught. The concrete shell is 5in. thick on the bottom, 4½in. on the sides, and 4in. on the bulkheads and decks.

FLOODS HAMPER PRODUCTION.—Particulars have now reached this country of the extensive damage done at the end of May in Pennsylvania. Torrential rains that swelled dozens of tributaries of the Susquehanna, Lehigh, Schuykill and Lackawanna rivers in Eastern and Central Pennsylvania caused a series of flash floods, and no fewer than thirty-five bridges were washed out—sixteen of them being major structures—and twenty-two State highway routes were blocked. The Bethlehem steel plant was forced to suspend operations for a time because of high water in the Lehigh River.

Miscellanea

NO HOARDING OF ESSENTIAL MATERIALS.—Under an Order, issued by the Chairman of the Canadian Wartime Industries Control Board, it has become an indictable offence to hoard or misuse steel, rubber, tin, zinc, copper, and other essential raw materials, of which enormous quantities are needed for the war effort. The penalty for infraction of this Order may be a fine of up to 5000 dollars or imprisonment for five years or both.

CANADA'S PRODUCTION OF EXPLOSIVES.—According to a statement issued by the Canadian Department of Munitions and Supply, production of explosives is now coming from thirty projects owned by the people of Canada. The plants cost close to 125 million dollars, and employ a personnel of 45,000, of which about one-third are women. They produce twenty or more types of chemicals and a wide range of explosives.

ALUMINIUM IN HUNGARY.—The Ungarische Bauxitgruben A.-G., a Hungarian company formed five years ago, has largely increased its capital for the financing of plant extensions. The company plans to build an alumina plant with an annual capacity of 20,000 tons and a metal plant with an annual output of 10,000 tons. Bauxite production by the mines last year was 50 per cent. more than in 1940, Germany taking most of it.

TUNGSTEN IN A WESTERN STATE.—A valuable find of tungsten is reported from North America. Mr. Donald E. White, of Stanford University, a geologist, was sent by the United States Geographical Survey into the Yellow Pine district of Idaho more than two years ago to investigate the antimony possibilities. Tungsten was discovered during the survey. The new ore body is estimated to be 150ft. wide, 500ft. long, and probably more than 1000ft. deep—the biggest tungsten strike ever made in the United States.

SUPPLY DEPARTMENT CONTRACTS.—The Association of British Chambers of Commerce has issued a pamphlet containing explanations given by the Ministry of Production regarding the normal procedure of departments in dealing with contractors and sub-contractors in connection with contracts for the Supply Departments. The pamphlet gives information concerning the facilities for assistance, advice, and appeal, which are open to all contractors and sub-contractors, and affords guidance as to the purpose of contract clauses and cost investigations. Copies of the pamphlet can be obtained from the Secretary of the Association, 14, Queen Anne's Gate, S.W.1, price 3d.

MACHINERY, PLANT, AND APPLIANCES.—Under the Machinery, Plant, and Appliances (Control) (No. 2) Order, 1942 (S.R. & O., 1942, No. 1175), which came into force on June 18th, 1942, new classes of machinery, plant, and appliances are added to those already listed in the previous Order (S.R. & O., 1942, No. 1), and certain of the classes already listed are amended. Further, certain amendments have been made of the body of the previous Order. Copies of the Order are obtainable from H.M. Stationery Office or any bookseller. Application forms for licences to acquire machinery, plant, and appliances falling within the schedules to the Orders may be obtained from the Machinery Licences Division, Board of Trade, 1–6, Tavistock Square, London, W.C.1.

MEN OF MAUDSLAYS.—A successful first visit of the newly formed society, Men of Maudslays, took place on Friday, July 3rd, when a party of the members, on the invitation of Mr. Cyril C. Maudslay, B.A., were shown over his extensive works at Smethwick. Here the heads of the various departments, together with the chief chemist, conducted the visitors in small groups over the entire works, engaged nearly all on the light metals side. After lunch, served in the canteen, with Mr. Maudslay in the chair and Mr. Pritchard in the vice-chair, the members proceeded by road another 3 miles or so to see the ironfoundries. The President of the society, Mr. W. H. A. Robertson, M.I. Mech. E., of Bedford, conveyed the thanks of the society for the interesting programme provided and for the hospitality which had been extended.

RUSSIAN-ENGLISH TECHNICAL DICTIONARY.—There is an urgent demand at the present time for an up-to-date Russian-English dictionary of scientific and technical terms. It is known that a number of Russian-English glossaries of specific terms have been compiled by various scientific institutions and individuals, and it is thought that it would be extremely helpful to scientists and technical translators if copies of these glossaries could be collected together and placed in the Science Library in London where one complete set could be consulted. If therefore any Institution or individual has compiled a glossary of Russian scientific or technical terms, whether printed or in manuscript, he is asked to send a copy to the secretary, Anglo-Soviet Scientific Collaboration Sub-Committee, The British Council, 3, Hanover Street, W.1, who will collect it for the Science Library. It is hoped at a later stage to compile a large dictionary, but the immediate aim is to collect the different glossaries in one place where they can be consulted. Each glossary will be known by the name of its compiler.

Personal and Business

SIR EDWARD CROWE has been elected President of the Royal Society of Arts.

MR. G. HENDERSON has been elected President of the Association of Mining Electrical Engineers.

MR. E. BRUCE BALL, jun., has been appointed joint managing director of Glenfield and Kennedy, Ltd.

SIR ALFRED FAULKNER has been appointed Director of Producer Gas Vehicles in the Ministry of War Transport.

MR. ROBERT RUSSELL, of the Royal Technical College, Glasgow, has been appointed Principal of the Coatbridge Technical College.

MR. A. S. TAIT has been appointed president of the English Electric Company, of St. Catherine's, Canada. He joined the company in 1934 and was appointed vice-president in 1940.

MR. F. SCOPES has been appointed managing director of the Stanton Ironworks Company, Ltd., in succession to Mr. E. J. Fox, who recently resigned after twenty-five years in that position.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Institute of Economic Engineering

Sunday, July 12th.—Waldorf Hotel, Aldwych, W.C.2. "Time Study Basis for Planning and Production Control," W. T. Laxton-Roberts. 2.30 p.m.

Institute of Fuel

Friday, July 17th.—Connaught Rooms, Great Queen Street, W.C.2. Luncheon meeting to Major Gwilym Lloyd George, M.P. 12.45 for 1.15 p.m.

Institution of Automobile Engineers

Tuesday, July 21st.—Royal Society of Arts, John Adam Street, Adelphi, W.C.2. "A Post-war Motor Vehicle," L. H. Hounsfield. 6.30 p.m.

Institution of Chemical Engineers

Tuesday, July 14th.—Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. Joint meeting. "The Separation of Gases," Dr. M. Ruhemann. 5.30 p.m.

Institution of Production Engineers

Monday, July 13th.—MANCHESTER SECTION: College of Technology, Manchester. Informal discussion on "Production Problems." 7 p.m.